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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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02 WATER CYCLE

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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04 WATER QUANTITY MANAGEMENT AND CONTROL

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05 WATER QUALITY MANAGEMENT AND PROTECTION

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06 WATER RESOURCES PLANNING

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

HYDROLOGIC ENGINEERING CENTER PLANNING MODELS,
Hydrologic Engineering Center, Davis, CA.
D. T. Ford, and D. W. Davis.
Water Resources Bulletin, Vol. 21, No. 1, p 135-143, February, 1985. 5 Fig, 37 Ref.

Descriptors: *Hydrologic models, *Model studies, *Computers, *Reviews, Statistical models, Planning, Water resources development, Catchments, Channels, Alluvial plains, Data management.

The US Army Corps of Engineers has broad, nationwide water resources planning and management responsibilities. In response to the needs of Corps professionals, the Hydrologic Engineering Center has developed and supports a family of computer programs designed to aid them in their work. These programs include catchment, channel, alluvial, and statistical process models, system operation models, plan evaluation models, and data management programs. These models individually and collectively have been used throughout the Corps in wide ranges of water resources planning studies. Future plans include improving existing models, converting existing models to execute on microcomputers, and developing new models to meet the needs of Corps study requirements. All new models developed now follow software engineering guidelines that are intended to yield programs that are reliable, easily transported from one computer system to another, readily modified, and easily supported and maintained. (Baker-IVI)
W85-06247

INVENTORY OF COURT CREEK WATERSHED CHARACTERISTICS THAT MAY RELATE TO WATER QUALITY IN THE WATERSHED,
Illinois State Water Survey Div., Peoria. Water Quality Section.
D. Roseboom, R. L. Evans, J. Erickson, and L. G. Brooks.
Illinois Department of Energy and Natural Resources, Document No. 83/23A. SWS Contract Report 322, August 1983, 102 and 135 p, 32 Fig, 30 Tab, 30 Ref, 8 Append (in separate volume).

Descriptors: *Land use, *Aerial photography, *Wildlife conservation, *Time series analysis, *Cropland, *Land classification, *Channeling, Land development, Strip mines, On-site data collections, Wildlife habitats, Surveys.

Land use changes in 98-sq. mile watershed are detailed on the basis of aerial photographs made from 1940 to 1979. The photographic analysis for 1979 was checked with ground surveys of the watershed. The major land use changes in agricultural watersheds were the conversion of pastures to row crops or wooded area. One large tributary, Sugar Creek, was altered from agriculture to strip mining and real estate development. Extensive stream channelization occurred in the broad glacial-alluvial valley in order to maximize row crop field size. Major bank erosion sites were apparent in the aerial photographs in the channelized areas. The study involved performing an inventory of the watershed, selecting stream sampling stations, installing measuring devices, and reconnoitering streams and terrain. The watershed will support about 280 whitetail deer, and quail populations will likely reach their highest counts per site (30-40) on woody stream corridors with a diversity of timber and pasture. The watershed will produce about 2,040 raccoons annually at an estimated value of $52,000. A Canadian goose population has been established in the strip mining area, and is starting to move into surrounding impoundments. Any conservation practices that will lead to more diversity of habitat will improve the quantity and quality of wildlife in the watershed. There are no known rare or endangered species using the watershed on a permanent basis. (Hawkins-Omniplan)
W85-06331

SPECIAL GROUND WATER STUDY, BASIN-WIDE REPORT AND EXECUTIVE SUMMARY.
Delaware River Basin Commission, West Trenton, NJ.
December 1982. 148 p. 27 Fig.

Descriptors: *Delaware River Basin, *Regional analysis, *Surface-groundwater relations, *Groundwater movement, *Confine aquifers, *Drilling, *Wells, Groundwater flow, Stream discharge, Groundwater storage, Artesian aquifers, Aquifers, Regional planning.

The surface and ground water resources of the Delaware River Basin are interrelated and act as a unit. Ground water constitutes a major portion of the flow of perennial streams. When wells are located farther from streams, flow impacts resulting from induced infiltration lessen. The unconsolidated Coastal Plain formations, and the glacial outwash deposits and carbonate aquifers in the Uplands are, in general, more easily recharged and have greater storage capacity than the remaining aquifers in the basin. Conjunctive use schemes that employ seasonal use of ground and surface water could minimize localized water supply and streamflow depletion problems associated with ground water development. Withdrawal limits guidelines for confined aquifer systems in the Coastal Plain should consider the extensive regional flow patterns characterized by these systems. These regional flow patterns preclude management on a watershed basis. Withdrawal limits guidelines for aquifer systems other than these confined aquifers should consider the interrelationship of surface water and ground water, and treat the resource as a single hydrologic system. Waste plume contamination problems are found in all aquifer groups. The Cohansey-Kirkwood aquifer and corbonate aquifers sensitive to dissolution are most likely to be adversely affected. Solutions for long-term management depend on detailed knowledge of the occurrence and movement of ground water. (Hawkins-Omniplan)
W85-06337

MEASURED EVAPORATION IN HIGH RAINFALL AREAS, LEEWARD KO'OLAU RANGE, OAHU, HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 2D.
W85-06345

ROCKY MOUNTAIN ACIDIFICATION STUDY,
Colorado State Univ., Fort Collins. Natural Resources Ecology Lab.
For primary bibliographic entry see Field 5C.
W85-06359

AUTOMATIC CALIBRATION OF CONCEPTUAL CATCHMENT MODELS USING DERIVATIVE-BASED OPTIMIZATION ALGORITHMS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
V. K. Gupta, and S. Sorooshian.
Water Resources Research, Vol. 21, No. 4, p 473-485, April, 1985. 11 Fig, 4 Tab, 30 Ref, 2 Append.
DOE grant DEACO 180RA50256, NWS grant NA 83AAA 02788, NSF grant CEE-8217823.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Algorithms, *Optimization, Catchment area, Model studies, Simulation, Calibration, Structural identifiability.

This paper examines the possibility of using derivative-based optimization algorithms for automatic calibration of conceptual rainfall-runoff models with threshold structures. A method is discussed for explicit computation of the derivatives based on an analysis of the modality of behavior present in such models. In the method the threshold structures are not replaced by smoothing functions, thereby preserving the conceptual integrity of these models. The discussion includes a theoretical analysis of a single linear reservoir (with threshold) model which provides some insights into the issue of threshold parameter identifiability. Simulation study comparisons of the Newton (derivative based) and the Simplex (direct search) optimization algorithms indicate that the former is more efficient, especially when the number of parameters to be optimized is large. However, the results indicate that careful study of the issues related to model identifiability is required if any significant progress is to be achieved in the area of automatic calibration of conceptual rainfall-runoff models. (Author's abstract)
W85-06502

ANALYSIS OF STRUCTURAL IDENTIFIABILITY: THEORY AND APPLICATION TO CONCEPTUAL RAINFALL-RUNOFF MODELS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. Sorooshian, and V. K. Gupta.
Water Resources Research, Vol. 21, No. 4, p 487-495, April, 1985. 3 Fig, 7 Tab, 24 Ref, 2 Append.
NSF grant CEE-8217823.

Descriptors: *Structural identifiability, *Rainfall-runoff relationships, *Mathematical models, Hydrologic models, Model studies, Parameter estimation.

The identification of a conceptual hydrologic model involves two stages: selection of a suitable model structure and parameter estimation. These two stages cannot be treated as distinct, and it is important that the limitations of available parameter estimation methodologies be given serious consideration during the procedure of model structure selection. This paper focuses on the concepts and tools necessary for the evaluation of whether the structure of a hydrologic model is such that its parameters can be successfully identified. A definition of structural identifiability is advanced that is based purely on model properties and is independent of the stochastic nature of the output observation errors. The approach is used to develop a measure of local structural identifiability which is useful in the analysis of parameter sensitivity. A measure, called the sensitivity ratio, is introduced which is suitable for studying parameter interactions in the multidimensional parameter space. Also, the use of allowable reparameterizations to improve identifiability is discussed. The utility of the concepts discussed in this paper are demonstrated by a simulation example using a conceptual rainfall-runoff model. (Author's abstract)
W85-06503

STOCHASTIC STREAMFLOW MODEL BASED ON PHYSICAL PRINCIPLES,
Portland State Univ., OR. Dept. of Civil Engineering.
R. W. Koch.
Water Resources Research, Vol. 21, No. 4, p 545-553, April, 1985. 8 Fig, 3 Tab, 29 Ref.

Descriptors: *Streamflow, *Stochastic process, *Model studies, *Rainfall-runoff relationships, Precipitation, Drainage, Storm seepage, Soil water, Hydrologic models.

Based on hydrologic arguments, a stochastic model for discretized streamflow from rainfall is proposed in the form of an averaged filtered Poisson process (FPP). Using a two-component description with excess precipitation and drainage as inputs to the surface and subsurface flow systems, simplified models are presented for the physical processes. The mean, variance, and covariance function of discretized streamflow are computed in terms of the first and second moments of excess precipitation and drainage which are derived analytically. The behavior of the stochastic properties of streamflow is evaluated for various soil types, basin travel times, and effective initial soil water contents. Where there is an intuitive feeling for the interaction of physical characteristics and stochastic properties, such as the mean, the model appears to produce qualitatively correct results. Prediction of stochastic properties is limited by the selection of an effective initial soil moisture value. (Author's abstract)
W85-06508

APPLICATION OF A CELL MODEL TO THE BELLEBEEK WATERSHED,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W85-06638

HYDROLOGICAL DATA-MODEL WORK IN GREENLAND,
Greenland Technical Organization, Copenhagen (Denmark).
Th. Thomsen, and G. H. Jorgensen.
Nordic Hydrology, Vol. 15, No. 1, p 39-56, 1984. 11 Fig, 3 Tab, 7 Ref.

Descriptors: *Hydrologic models, *Greenland, *Rainfall-runoff relationships, *Ablation runoff, Precipitation, Ice, Drainage basins, Melting, Rainfall, Snow, Freezing, Glaciers.

The hydrological regions vary greatly in Greenland, depending on whether the drainage basin is influenced by ablation runoff. To describe a runoff time series from these areas, a hydrological model calibration is made, followed by a simulation. In drainage basins influenced by rain and snow only, a slightly modified version of the precipitation runoff model (NAM) is applied. The parameter transfer for the determination of model input is found by intensive data analysis work between Nuuk and Kangerluarsunnguup Tasersua for temperature and precipitation along with detailed investigation in the basin. This is to ensure that a too short calibration period in connection with the adaption of a hydrological model to the basin data is balanced in such a manner that these adapt the hydrological model, and not vice versa. In drainage basins also influenced by ablation runoff it is not possible to use a traditional precipitation runoff model but a hydrological ablation model has been developed in cooperation with the Geological Survey of Greenland. The hydrological ablation model describes the transfer of the temperature after heating and cooling factors as well as snow mobility on the ice, melting density criteria, and refreezing. The model is applied to the hydrological basin of Paakitsup Akuliaruserua at Ilulissat where 90% of the drainage basin is covered by the ice cap. (Baker-IVI)
W85-06639

RUNOFF PATTERN AND PEAK FLOWS FROM MOVING BLOCK RAINS BASED ON A LINEAR TIME-AREA CURVE,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 2E.
W85-06647

LAND ENVIRONMENTS OF WATER RESOURCE MANAGEMENT,
Georgia Univ., Athens. School of Environmental Design.
B. K. Ferguson.
Journal of Environmental Systems, Vol. 14, No. 3, p 291-312, 1984-85. 9 Fig, 4 Tab, 27 Ref.

Descriptors: *Resources management, *Water management, *Landforms, Hydrologic properties, Soil properties, Bedrock, Water resources development, Planning, Physiography.

This article attempts to look across a broad range of hydrologic disciplines in order to compare the types of hydrologic phenomena and processes that occur in different types of land environments, and to develop a conceptual framework for basic hydrologic classification of land. It emphasizes the qualitative types of hydrologic processes that may occur in the landscape, rather than quantitative rates of flow. The framework was developed by reclassifying physiographic land forms according to hydrologic characteristics, and examining different landform types in photographs and on the ground. The framework is based around landform, hydroclimate, and regional aquifers and rivers. Landforms are characterized as hydrologically 'positive' or 'negative,' with positive landforms being further broken down by permeability of soil and bedrock. Such a framework could help to guide early water resource planning decisions by aiding the comparison of contrasting needs and potentials of different areas. It can thus have important implications for the types of solutions to water resource issues that are attempted. (Author's abstract)
W85-06695

NEW MATHEMATICAL MODELING SYSTEM,
University of the Pacific, Stockton, CA. Dept. of Civil Engineering.
R. C. Johanson.
ACS Symposium Series, Vol. 259, p 125-147, 1983. 12 Fig, 13 Ref.

Descriptors: *Hydrologic models, *Mathematical models, *Simulation, Sedimentation, Pesticides, Fate of pollutants, Hydrolysis, Photolysis, Oxidation, Streams, Rivers, Lakes.

The Hydrological Simulation Program - Fortran (HSPF) simulates the movement of water, sediment and many associated constituents over and under the land surface, and through streams, rivers and shallow lakes. It is a relatively new package, funded by the EPA. There are two classes of operating module in HSPF: application modules - which simulate the behavior of processs which occur in the real world, and utility modules which perform housekeeping operations on time series. The Pervious Land-segment Module (PERLND) is discussed with emphasis on hydrologic simulation, sediment simulation, and pesticide simulation. Other modules discussed include the Impervious Land-segment module (IMPLND); the Reach/reservoir module (RCHRES), with emphasis on hydraulic routing, sediment routing, and pesticide simulation; utility modules; software design considerations; and operation of the model. Experience with HSPF shows that programming errors are rare, and the code is easy to follow. Operating modules and individual subprograms have been added or modified with relative ease. Adaptation of HSPF to computers with widely differing memory configurations and word lengths has been relatively simple. The program has been used in a variety of situations ranging from simple single land-segment simulations to studies involving complex networks. (Baker-IVI)
W85-06767

BASIC HYDROLOGY,
Memorial Univ. of Newfoundland, St. John's.
J. J. Sharp, and P. G. Sawder.
Butterworth, Boston. 1984. 150 p.

Descriptors: *Hydrology, *Computer programs, *Precipitation, *Runoff, Surface runoff, Rainfall, Hydraulic engineering, Engineering, BASIC, Depth-area-duration analysis, Evaporation, Evapotranspiration, Frequency analysis, Streamflow, Hydrographs, Reservoir design.

The basic elements of the computer language BASIC and hydrology are combined for undergraduate students and practicing engineers. The essential theory and examples of computer programs are given for precipitation, evaporation, frequency of rainfall, stream flow and surface runoff, the unit hydrograph, and reservoir design.
W85-06931

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 4: DIEL PERIODICITY OF BENTHIC MACROINVERTEBRATE DRIFT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. R. Bingham, S. P Cobb, and A. D. Magoun.
Miscellaneous Paper E-80-1, December 1980. Report 4 of a Series. 31 p, 11 Fig, 1 Tab, 15 Ref, 1 Append.

Descriptors: *Benthos, *Rivers, *Macroinvertebrates, *Benthic fauna, *Diurnal distribution, *Species composition, *Species diversity, *Aquatic habitats, Biological samples, Baseline studies, Habitats, Dikes, Fisheries, Fish management, Ecological effects, Lotic environments.

A diel periodicity study of drifting benthos resulted in the collection of 5090 macroinvertebrates consisting of 80 taxa. Average drift density over all sampling times was 140 organisms/100 cu m of water filtered. Concentrations of organisms collected were significantly lower at dawn than at other sampling times. The lack of pronounced diel periodicity in total drift resulted from off-setting of dominant day active versus night active species. Hydropsyche spp., the most abundant taxon, was nocturnally active. Hydra sp., a diurnal drift component, was the second most dominant taxon. Species diversity was significantly lower during daylight hours and highest at dusk, midnight, and dawn. Of the nine most dominant taxa, five were most abundant at midnight, two most abundant at dusk, one most abundant at afternoon, and one most abundant at noon. Various taxa displayed behavioral drift characteristics. The total transport of benthic drift downstream in a 24-hr period was calculated as 1.5 times ten to the 9th power organisms/day based on a river discharge of 12,063 cu m/sec. Total diel drift standardized by river discharge was 120,000 organisms/day/cu m/sec, slightly higher than reported for other rivers but of the same order of magnitude.
W85-06995

REGRESSION ANALYSIS OF RIVER PROFILES,
Kentucky Univ., Lexington. Dept. of Geology.
R. G. Shepherd.
Journal of Geology, Vol. 93, No. 3, p 377-384, May, 1985. 5 Fig, 3 Tab, 24 Ref.

Descriptors: *Least squares method, *Regression analysis, *River profiles, *Texas, Bedrock streams, Flow profiles, Profiles, Flow, River beds, Curvature, Rugosity.

The longitudinal profile of a river is a plot of bed elevation versus distance along the channel. Least squares regression statistics were plotted for 13 profiles of bedrock streams in the Llano region of central Texas for the purpose of comparing the relative merit of each of Strahler's (Strahler, A.N., 1964, Quantitative Geomorphology, in Chow, V. T. ed., Handbook of Applied Hydrology, New York, McGraw-Hill, Chap. 4) four equations as a profile descriptor using a variety of natural profiles. The least square regression comparison of linear, exponential, logarithmic, and power functions for the profiles demonstrated that: a standard method of plotting profiles from source to mouth should be followed; the exponential function is preferred for profiles ending downstream in aggradational areas; the logarithmic function is preferred for profiles that terminate upstream at scarps or steep divides; the power function is inadequate for most longitudinal profiles; a composite function is recommended for complete profiles; and a power regression of slope against distance provides the most useful method of describing and comparing curvature and rugosity, two basic properties of profiles. (Baker-IVI)
W85-07037

INVENTORY OF THE WORLD'S WATER,
F. H. Forrester.
Weatherwise, Vol. 38, No. 2, p 82-86 and 105, April, 1985. 4 Fig.

Descriptors: *Hydrologic cycle, *Water budget, Atmosphere, Oceans, Precipitation, Rainfall, Rivers, Streams, Groundwater, Glaciers.

The sheer volume of our planet's water - locked in glaciers, stored in lakes, detained in underground rocks, or moving in the atmosphere, river and seas - almost defies the imagination. Views of the earth from space confirm that water covers about 70% of the earth's surface. Usable fresh water amounts to less than 1% of the total. The approximately 320 million cu mi of sea water constitute about 97.2% of the planet's total water supply. The amount of water stored in frozen form represents 2.15% of the world's water. Below the vadose water, the planet contains a water reservoir - groundwater. The volume of all the large freshwater lakes in the world aggregate nearly 30,000 cu mi. Five hundred cubic miles is the amount estimated to be present in river channels throughout the world at any given moment. Considering the atmospheric

ocean as the last source of water, on the average about once every 12 days or so, the water in the air falls and then is replaced. About 102,000 cu mi of water rise into the air annually. Of this amount 78,000 cu mi fall directly back into the oceans. Streams and rivers collect and return to the oceans some 9,000 cu mi of water, including a large quantity that has percolated down into the ground and that, as ground water, moves slowly to natural outlets in the banks and channels of rivers. (Baker-IVI)
W85-07077

2B. Precipitation

COMPARISON OF RAINFALL REGIMES AT SIX SITES IN NORTHERN SYRIA,
Reading Univ. (England). Dept. of Agricultural Botany.
M. D. Dennett, J. D. H. Keatinge, and J. A. Rodgers.
Agricultural and Forest Meteorology, Vol. 31, No. 3/4, p 319-328, June, 1984. 9 Fig, 2 Tab, 6 Ref.

Descriptors: *Rainfall, *Syria, *Model studies, Precipitation, Statistical methods, Rainfall intensity, Rainfall distribution.

Daily rainfall data for six sites in northern Syria was obtained for from 11 to 25 complete rainfall years. Mean average rainfall at the sites ranged from 214 to 479 mm. The rainfall regimes at the six sites are compared by fitting a model of daily rainfall for each site. The components of the model, the probability of rain and the mean amount of rain per rainday, vary systematically between sites. Statistics describing a number of agriculturally important rainfall characteristics are derived from the models. The fitted models provide a concise, clear summary of the rainfall regimes and visual comparisons of sites can easily be made. Comparison of the rainfall models provides a clear overall assessment of the importance of the various factors contribution to annual rainfall totals. Thus it is possible to see rapidly whether sites differ in the duration and timing of the rainy season or in the intensity and persistence of rainfall within this season. (Baker-IVI)
W85-06194

PALMER DROUGHT SEVERITY INDEX AS A MEASURE OF HYDROLOGIC DROUGHT,
Geological Survey, Reston, VA.
W. M. Alley.
Water Resources Bulletin, Vol. 21, No. 1, p 105-114, February, 1985. 4 Fig, 4 Tab, 27 Ref.

Descriptors: *Drought, *Hydrologic drought, *Palmer Drought Severity Index, Streamflow, Groundwater, Climate, Hydrologic properties.

The Palmer Drought Severity Index (PDSI) is perhaps the most widely used regional drought index. However, there is considerable ambiguity about its value as a measure of hydrologic drought. In this paper the PDSI for climatic divisions in New Jersey is compared to the occurence within each climatic division of streamflows in their lower quartile for the month (streamflow index), and ground-water levels in their lower quartile for the month (ground-water index). These indices are found to have distinct properties. It is not uncommon for PDSI values to indicate 'severe' or 'extreme' drought at times when the streamflow or ground-water index is above its lower quartile at many stations within the climatic division. The PDSI values and groundwater index indicate more persistent subnormal conditions than the streamflow index for truncation levels yielding the same total duration of drought over a period. The ground-water index tends to indicate a later beginning to droughts and of the three indices is the most conservative indicator of a drought's end. Drought timing and duration properties for the ground-water index are found to be highly influenced by the average depth to water in the well. Overall, the three indices of drought can provide three very different characterizations of drought. In particular, the results indicate that considerable caution should be exercised in drawing conclusions about hydrologic drought from the PDSI. (Author's abstract)
W85-06245

CLIMATE FLUCTUATIONS IN ILLINOIS: 1901-1980,
Illinois State Water Survey Div., Champaign.
S. A. Changnon, Jr.
Illinois State Water Survey Bulletin 68, 1984, 77 p, 68 Fig, 8 Tab, 20 Ref.

Descriptors: *Climatology, *Wet climates, *Climatic data, *Precipitation intensity, *Rainfall intensity, *Snow depth, *Time series analysis, Fluctuations, Temperature, Thunderstorms, Frost, Freezing, *Illinois.

Changes in climate directly affect four areas of major activity and concern in Illinois --water, energy, agriculture, and transportation. Selected Illinois records are presented for 1901-1980 on a variety of atmospheric conditions. The data reveal moderate to large fluctuations with time, and in many cases notable trends over part or the entire 80-year period. The recent precipitation data reveal a period of relatively wet conditions. The 1961-1980 period had relatively heavy annual precipitation, more days of precipitation at all levels (ranging from 0.01 inch to more than 2 inches), more snowfall and deeper snow depths, and more freezing rain days than earlier years. The tendency to a wetter climate was found in all seasons. Temperatures in the last 20 years show a marked trend toward colder conditions, but only in winter and summer. In contrast to winter and summer, the climate changes in spring and fall have been much less, except to become slightly wetter. The slightly warmer Springs in the last 25 years have made the average date of the last freeze occur slightly earlier than before, producing a slight increase in the growing season length during the last 20 years. Visibilities have generally decreased, particularly in the summer. Thunderstorms decreased in the southern half of the state. (Hawkins-Omniplan)
W85-06346

EXPLORATORY ANALYSIS OF PRECIPITATION EVENTS WITH IMPLICATIONS FOR STOCHASTIC MODELING,
National Center for Atmospheric Research, Boulder, CO. Environmental and Societal Impacts Group.
B. G. Brown, R. W. Katz, and A. H. Murphy.
Journal of Climate and Applied Meteorology, Vol. 24, No. 1, p 57-67, January, 1985. 10 Fig, 19 Ref.

Descriptors: *Precipitation, *Model studies, *Selma, *Oregon, Mathematical studies, Erosion control, Statistical analysis, Rainfall intensity.

The use of a concept called a percipitation event to obtain information regarding certain statistical properties of precipitation time series at a particular location and for a specific application (e.g., for modeling erosion) is described. Exploratory data analysis is used to examine several characteristics of more than 31 years of primitive precipitation events based on hourly precipitation data at Salem, Oregon. A primitive precipitation event is defined as one or more consecutive hours with at least 0.01 inches (0.25 mm) of precipitation. The characteristics of the events that are considered include the duration, magnitude, average intensity and maximum intensity of the event and the number of hours separating consecutive events. By means of exploratory analysis of the characteristics of the precipitation events, it is demonstrated that the marginal (i.e., unconditional) distributions of the characteristics are positively skewed. Examination of the conditional distributions of some pairs of characteristics indicates the existence of some relationships among the characteristics. For example, it is found that average intensity and maximum intensity are quite dependent on the event duration. The existence and forms of these relationships indicate that the assumption commonly made in stochastic models of hourly precipitation time series that the intensities (i.e., hourly amounts within an event) are independent and identically distributed must be violated. Again using exploratory data analysis, it is shown that the hourly intensities at Salem are, in fact, stochastically increasing and positively associated within a precipitation event. (Author's abstract)
W85-06427

RADAR DETERMINATION OF SNOWFALL RATE AND ACCUMULATION,
Air Force Geophysics Lab., Hanscom AFB, MA.
R. J. Boucher, and J. G. Wieler.
Journal of Climate and Applied Meteorology, Vol. 24, No. 1, p 68-73, January, 1985. 5 Fig, 2 Tab, 16 Ref.

Descriptors: *Snow, *Precipitation, *Radar, Estimating, Storms.

A unique method that provides for relating radar-measured reflectivity factors to snowfall rates at the ground is presented. Data were provided by a CPS-9, 3.2 cm radar from six 1978 Massachusetts snowstorms. A best-fit power-law relationship between hourly-averaged snowfall rate (depth) and radar reflectivity factor is determined. This derived relationship is found to be $Z = 5.07S(1.65)$ with a correlation coefficient of 0.91. With this relationship hourly snowfall rates are found to be accurate to within +41 to -29% and total storm snowfall accumulation to within +44 to -31%. (Author's abstract)
W85-06428

PRECIPITATION INTENSITY AND VARIABILITY AT CHILTON VALLEY, NEAR CASS, SOUTHERN ALPS,
Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
A. P. Sturman, and J. M. Soons.
Journal of Hydrology, Vol. 23, No. 1, p 10-20, 1984. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Precitipation intensity, *Chilton Valley, *Southern Alps, *South Island, *New Zealand, Time series analysis, Seasonal variation, Cyclonic precipitation.

The precipitation regime of the Chilton Valley in the Southern Alps, South Island, New Zealand, is examined using monthly and half hourly data. Missing monthly totals are estimated using data from nearby stations to produce a complete time series from August 1964 to December 1982. Monthly precipitation totals indicate marked wet and dry periods. The annual precipitation regime has two distinct maxima: a maximum in spring and a sub-maximum in April. Minima are observed during February and March, and in July. There are generally weak but statistically significant links between cyclonicity, westerly airflow and precipitation. Analysis of half hourly precipitation confirms earlier studies quoting relatively low intensities, with lowest values in July, August and September. Although cyclonicity is most important for the monthly totals, westerly airflow is more important for higher intensities. (Author's abstract)
W85-06433

STOCHASTIC MODEL OF DIMENSIONLESS THUNDERSTORM RAINFALL,
Agricultural Research Service, Tucson, AZ.
D. A. Woolhiser, and H. B. Osborn.
Water Resources Research, Vol. 21, No. 4, p 511-522, April, 1985. 12 Fig, 4 Tab, 31 Ref.

Descriptors: *Stochastic process, *Model studies, *Rainfall, *Thunderstorms, *Arizona, Storms, Precipitation, Rainfall distribution.

A concise stochastic model for the nondimensional thunderstorm rainfall process at a point is proposed. The accumulated precipitation process for individual thunderstorms is nondimensionalized by dividing the precipitation at any time by the total precipitation and the elapsed time by the total duration. The dimensionless process is divided into 100 equal time increments, and the depth increments are rescaled to range between 0 and 1. The sequence of rescaled increments Z1, Z2,..., Z9 are assumed to represent a nonhomogeneous Markov process in discrete time with continuous state space. The expected value of the kth rescaled

increment, given the k - 1st increment, is assumed to be a linear function of that increment, and the marginal distribution of the first increment and the conditional distributions are assumed to be described by the beta distribution. An analyses of data for 275 thunderstorms observed at the Walnut Gulch Experimental Watershed in southeastern Arizona showed that the proposed model structure is a good approximation for this region. The number of model parameters can be reduced from 26 to a minimum of 10 by approximating the 2 parameters in the conditional expectation function and the conditional beta parameter as polynomial functions of the dimensionless time. Likelihood ratio tests and the Akaike information criterion suggest that the dependence parameters are independent of storm amount and duration but the conditional beta parameter alpha sub k is larger for short-duration storms than for long-duration storms. A 13-parameter model is recommended for disaggregating thunderstorm rainfall in southeastern Arizona. (Author's abstract)
W85-06505

CLIMATIC CONSTRAINTS TO WATER RESOURCE DEVELOPMENT IN THE SUDANO-SAHELIAN ZONE OF NIGERIA,
Bayero Univ., Kano (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 6D.
W85-06546

DYNAMIC PROPERTIES OF RAINFALL IN LUND,
Lund Univ. (Sweden).
J. Niemczynowicz, and P. Dahlblom.
Nordic Hydrology, Vol. 15, No. 1, p 9-24, 1984. 11 Fig, 6 Tab, 6 Ref.

Descriptors: *Rainfall distribution, *Lund, *Sweden, *Rainfall-runoff relationships, Rainfall velocity, Storms, Storm velocity, Wind, Statistical analysis, Seasonal variation.

The shape of a runoff hydrograph depends on the dynamic properties of the rainfall. The possible range of impact of the rainfall movement on runoff generating process can only be judged if the rainfall velocity and direction are known in statistical terms. This paper gives the statistical characteristic of the rainfall movement in the city of Lund (Sweden). The probability distribution of rainfall velocities and relative frequencies of the rainfall direction are based on the analysis of 400 rainfall events observed in the city of Lund. A simple program for determination of the velocities and the directions of storm movement has been developed and tested. Results show that there are two main storm directions in Lund: the first, generally oriented to the east, is prevalent throughout the year except summer; the second, oriented to the north-north-east, occurs primarily during summer months. During summer rainfall velocity is lower and intensity higher than during the rest of the year. Rainfall velocity is lognormally distributed. A strong correlation between wind movement parameters at 700 mb height and storm velocity and direction was observed. (Author's abstract)
W85-06637

INVESTIGATION OF THE INFLUENCE OF RAINFALL MOVEMENT ON RUNOFF HYDROGRAPH. PART I - SIMULATION ON CONCEPTUAL CATCHMENT,
Lund Univ. (Sweden).
For primary bibliographic entry see Field 2E.
W85-06640

INVESTIGATION OF THE INFLUENCE OF RAINFALL MOVEMENT ON RUNOFF HYDROGRAPH. PART II - SIMULATION ON REAL CATCHMENTS IN THE CITY OF LUND,
Lund Univ. (Sweden).
For primary bibliographic entry see Field 2E.
W85-06641

CHANGES IN CHEMICAL COMPOSITION OF PRECIPITATION AS IT FALLS (OB IZMENENII KHIMICHESKOGO SOSTAVA ATMOSTERNYKH OSADKOV V PROTSESSE IKH VYPADENIYA),
For primary bibliographic entry see Field 5B.
W85-06808

COMPUTER-ASSISTED DATA PROCESSING AND ANALYSIS SYSTEM FOR GROUND-BASED METEOROLOGICAL DATA COLLECTION,
Atmospherics, Inc., Fresno, CA..
For primary bibliographic entry see Field 7C.
W85-06924

PRECIPITATION GAGE NETWORK OPERATIONS FOR WINTERTIME RESEARCH IN THE CENTRAL SIERRA NEVADA,
Atmospherics, Inc., Fresno, CA..
M. Henderson, S. Pinion, E. Pinion, T. Henderson, and M. Solak.
Technical Report AISCP-843, July 1984. 36 p, 3 Fig, 12 Photos, 10 Ref. Contract/Grant No. 9-07-85-V0020.

Descriptors: *Precipitation, *Network design, *Gages, *Weather modification, *Rain gages, Sierra Nevada, California, Cloud seeding, Orographic precipitation, Sierra Cooperative Pilot Project, Cloud physics, Snow, Ice, Measuring instruments.

This document describes the development, installation and maintenance of a precipitation gage network in the Central Seirra Nevada of California. Emphasis is given to calibration techniques performed on Belfort weighing rain gages. It contains detailed steps related to key aspects of gage maintenance, calibration, installation and operation important to meeting SCPP requirements. This report is intended to be a practical guide for those responsible for obtaining high quality precipitation records with a minimum of data loss under a variety of installation and climatic conditions, but particularly in wintertime applications. (Author)
W85-06925

SAHEL: THE CHANGING RAINFALL REGIME AND THE 'NORMALS' USED FOR ITS ASSESSMENT,
Missouri Univ.-Columbia. Dept. of Atmospheric Science.
A. V. Todorov.
Journal of Climate and Applied Meteorology, Vol. 24, No. 2, p 97-107, February, 1985. 8 Fig, 4 Tab, 13 Ref.

Descriptors: *Rainfall distribution, *Sahel, *Drought, *Senegal, *Mali, *Upper Volta, *Niger, Hydrologic data collections, Data interpretation, Climatology, Forecasting.

Rainfall amounts in the Sahel region of Africa began a decline around 1968 that has continued to the present. The drought of 1982-83 was more severe and devastating than the well-known drought of 1972-73. Most years between 1972 and 1983 experienced below to well-below normal rainfall. These 16 or so dry years make obsolete mean (or normal) rainfall data calculated for periods before the decline began. Despite this, the old normal values are still widely used for various national and international agricultural projects. Discrepancies between the old and new mean values for the amounts of rainfall, and differences in the duration of the rainy season, suggest that mean or normal rainfall data should be calculated for the last 30 and/or 16 years. The rapidly changing climate in the Sahel requires more frequent updating of the climatological normals. (Author's abstract)
W85-07066

PRECIPITATION TRENDS AND WATER CONSUMPTION RELATED TO POPULATION IN THE SOUTHWESTERN UNITED STATES, 1930-83,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
H. F. Diaz, R. L. Holle, and J. W. Thorn, Jr.
Journal of Climate and Applied Meteorology, Vol. 24, p 145-153, February, 1985. 7 Fig, 1 Tab, 22 Ref.

Descriptors: *Precipitation, *Water consumption, *Human population, *Colorado River Basin, *Utah, Population dynamics, Water supply, Drought, Climatology, History, Dendrochronology, Paleoclimatology.

The possible effects of climatic fluctuations on renewable water supplies in the western United States was examined, especially as it is impacted by the growth of population and water consumption in recent decades. Precipitation fluctuations in the Colorado River Basin states have differed depending upon their location, but have tended to fluctuate with a time scale of one to two decades. Longer-term regimes may also be operative. For example, the Upper Basin states (Colorado and Utah) experienced a prolonged wet interval from about the turn of this century to around 1930; from 1930 to around 1978, drier than normal years tended to outnumber wet ones; since 1978 the Upper Basin has been exceedingly wet. Lower Basin states also experienced the early wet period and drier conditions after the mid-1940's, but they undergo somewhat different alternations of wetness and dryness. However, from the point of view of water supply, precipitation variability in the Upper Basin, particularly in Colorado, is more critical. Reservoir capacity in the arid western states is expected to gain little in additional storage capacity during the next couple of decades; in addition, withdrawal of water from the Colorado River is approaching the legal limits. The effect of a future prolonged drought on the order of those which have occurred in recent decades, or in a worse case, those inferred to have occurred in past centuries from tree ring studies, could have far more serious consequences than any in previous experience due to the large population increases in the region. These population trends show all signs of continuing, at least in the near future. The impact of a drought, however, would depend on the level of reservoir capacity that is present at the time of drought onset as well as its intensity and longevity; reservoirs in the West are presently at or near capacity. (Author's abstract)
W85-07067

EFFECT OF SEASONAL VARIATION OF SERIAL CORRELATION ON THE EXTREME VALUE DISTRIBUTION OF RAINFALL DATA,
Royal Netherlands Meteorological Inst., De Bilt.
T. A. Buishand.
Journal of Climate and Applied Meteorology, Vol. 24, p 154-160, 1985. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Serial correlation, *Seasonal variation, *Rainfall distribution, *Extreme value distribution, Statistical analysis, Mathematical analysis, Statistics, Clustering.

For practical applications both the parent distribution of rainfall intensities and the distribution of their annual maxima are of interest. The relation between these two distributions cannot be obtained from classical extreme value theory because of seasonal variation and serial correlation in the data. Mathematical results for the distribution of maxima in m-dependent sequences (e.g., an mth order moving average process) are given to illustrate the effect of local dependence on the extreme value distribution. High-level exceedances occur in clusters when there is strong local dependence. The average number of exceedances in a cluster is an important parameter in the relation between the parent and extreme value distribution. For 5-min rainfall data from De Bilt, quantiles of the annual maxima are overestimated by about 10 mm/h if the effect of serial correlation is ignored. This bias can easily be removed by taking local clustering of large rainfall intensities in a rainy spell into account. It is not necessary to describe the seasonal variation in the rainfall process to correct for dependence. (Author's abstract)
W85-07068

RELATIONSHIP OF PRECIPITATION TO VERTICAL MOTION OBSERVED DIRECTLY BY A VHF WIND PROFILER DURING A

SPRING UPSLOPE STORM NEAR DENVER, COLORADO,
National Oceanic and Atmospheric Administration, Boulder, CO. Aeronomy Lab.
K. S. Gage, and G. D. Nastrom.
Bulletin of the American Meteorological Society, Vol. 66, No. 4, p 394-397, April, 1985. 6 Fig, 12 Ref.

Descriptors: *Precipitation, *Wind, *Vertical motion, *Denver, *Colorado, Storms, Weather, Rainfall rate, Radar.

A comparison was made between directly measured vertical motion observed by the Platteville radar with rainfall rates measured at two locations downwind of the radar. An upwind site would not be expected to correlate as well since changes in upward motion must precede changes in rainfall rate observed at the source. Also, it takes time for the precipitation to reach the surface, so it is reasonable to expect a time lag of 15 minutes or more between a change in vertical motion and a change in rainfall rate observed at the surface. Since in this event snow was falling above 2 km MSL or so, the time lag should be closer to an hour. In view of all of this it would appear that mesoscale variability in vertical motion can be seen in rainfall rates if the scale of the variability is not too small and if the rain gauges are suitably located. In the present case there seems to be a fairly good correlation between the gross features of the vertical motion and the rainfall rates observed downwind. Even some of the variability in vertical motion and rainfall rates on time scales of a few hours seems to be correlated. This research is still in the exploratory stage and clearly more should be accomplished in planned experiments. (Baker-IVI)
W85-07075

AFRICA IN DROUGHT - A CHANGE OF CLIMATE,
National Acid Precipitation Assessment Program, Washington, DC.
D. Winstanley.
Weatherwise, Vol. 38, No. 2, p 74-81, April, 1985. 7 Fig.

Descriptors: *Africa, *Drought, *Climate, Rainfall, Weather, Precipitation, Sahel.

The possibility that recent droughts in Africa are part of a long term climatic change is investigated. New evidence that the climates of Africa have indeed been shifting, with startling consistency, over the past century or even longer is presented. Whereas most analyses of time series of annual rainfall in Africa have been restricted to twentieth century data, this research is based on a time series constructed back to the nineteenth century. Thus a 130 year index of changes in rainfall levels has been constructed in a continent wide zone to the south of the Sahara Desert. This longer time perspective provides a more confident basis for interpreting recent events than do twentieth century data alone. Over the past 20 years rainfall in this zone has averaged about 20% below normal. During the second half of the 19th century rainfall in this same zone had been about 20% above normal. The present droughts in this area are part of a long term trend toward lower rainfall, not merely short term climatic fluctuations. Rainfall levels in parts of equatorial Africa can be seen, through the same records, to be changing in the opposite direction. The area between the region showing a long term decline in rainfall and those showing a long term increase is characterized by marked climatic fluctuations from year to year and from decade to decade. The causes of these long term trends appear to be primarily, if not entirely, natural. The significance of a continuation of these natural trends to the welfare of the various African nations and people involved would seem to deserve very serious attention. (Baker-IVI)
W85-07076

SPECIFICATION OF UNITED STATES SEASONAL PRECIPITATION,
New Jersey Agricultural Experiment Station, New Brunswick.
R. P. Harnack, and J. R. Lanzante.
Monthly Weather Review, Vol. 113, No. 3, p 319-325, March, 1985. 1 Fig, 5 Tab, 12 Ref. NSF grant ATM-8217215.

Descriptors: *Precipitation, *Seasonal variation, Prediction, Sea surface temperature, Precipitation frequency, Empirical orthogonal function.

Seasonal precipitation is specified for the United States by matching various area-averaged precipitation statistics as predictands with three different predictors in turn: 700 mb heights, North Pacific SST (sea surface temperature) and North Atlantic SST. Predictors are in form of empirical orthogonal function (EOF) amplitude time series. The predictands used in trials include total precipitation and precipitation frequencies derived using three different critical values: 2.5, 12.7 and 25.4 mm. Screening multiple linear regression is used to relate predictands to predictors for samples ranging from 24 to 35 years in length; initially trials are compared in terms of area-averaged true skill and percent area of local significance. In order to assess specification skill on an independent sample, additional tests are made using a jackknife regression approach. Results suggest that skillful seasonal precipitation prediction will continue to be very difficult using predictors and methods presently in common use based on the use of specification equations on an independent sample. Generally, area-averaged explained variances are less than 10% and the area of significant local skill is less than 50%. Based on the low level of specification skill, predictive skill for precipitation using specification equations with imprecisely known specifier fields (like 700 mb heights) as input would be effectively zero. Other conclusions are: 1) 700 mb heights specify seasonal precipitation about equally well in winter, spring and summer, but worse in fall. 2) Among the three predictor types employed, 700 mb heights are best for all seasons but fall, when Pacific SST does best. Specification using Atlantic SST is poor in all instances and inferior to the use of the other predictor fields. 3) Overall among the four precipitation statistics used as predictands, the frequency statistics have a slightly better relationship with 700 mb heights or Pacific SST than do precipitation totals. (Author's abstract)
W85-07141

2C. Snow, Ice, and Frost

EFFECT OF GLACIERS ON STREAMFLOW VARIATIONS,
Geological Survey, Tacoma, WA.
For primary bibliographic entry see Field 2E.
W85-06512

UNIFIED DEGREE-DAY METHOD FOR RIVER ICE COVER THICKNESS SIMULATION,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
H. T. Shen, and P. D. Yapa.
Canadian Journal of Civil Engineering, Vol. 12, No. 1, p 54-62, March, 1985. NOAA contract NA 80RAC00147, St. Lawrence Seaway Development Corp. contract DRSL55-83-C0215.

Descriptors: *St. Lawrence River, *Ontario, *Ice cover, *Simulation, *Degree-days, Mathematical models, Thawing, Rivers, Frazil ice, Heat transfer.

The theoretical basis of the degree-day method is examined. A unified degree-day model for simulating the variations of river ice cover thickness throughout the entire winter is proposed, and applied to ice covers in the 160 km international section of the upper St. Lawrence River between Lake Ontario and Cornwall, Ontario. The thermal growth and decay of a river ice cover is affected by the meteorological conditions, the thickness of the snow and ice covers, the temperature and the flow conditions of the river water, the possible accumulation of frazil ice on the underside of the ice cover, and thermal properties of the ice cover. A simplified analytical procedure is used to examined the validity of the existing degree-day method, and factors that affect the value of the numerical constants. A new degree-day model is then proposed based on these analyses. The analysis shows the importance of the inclusion of the initial cover thickness. A variable coefficient is needed in order for the degree-day formula to be able to simulate the ice cover thickness continuously from the growth period to the decay period. The effect of the turbulent heat transfer from the river water can be accounted for by a simple linear function of time. A modified degree-day method is developed based on the theoretical analysis. The method is capable of simulating continuously the variation of the thickness of a river ice cover from formation to breakup. Application of the method to the upper St. Lawrence River shows that the simulated ice thickness compares well with the field observations. (Baker-IVI)
W85-06551

CHARACTERISTICS OF THE HYDROLOGY OF SIBERIAN RIVERS BASED ON EXPERIENCE IN THE DESIGN AND CONSTRUCTION OF HYDROELECTRIC STATIONS,
Ya. L. Gotlib.
Hydrotechnical Construction, Vol. 18, No. 2, p 86-90, February, 1984. 3 Fig, 17 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 36-39, February, 1984.

Descriptors: *Ice jams, *Dam construction, *Dam design, *Siberia, *USSR, Hydrology, Ice, Thermal regime, Reservoir management, Ice formation, Permafrost.

Among the characteristics of the hydrologic regime for designing and constructing Siberian hydrostations, problems related to the ice and thermal regime are very complex. These factors, and how they change, are also very important during operation of the hydrostations. The issues addressed in this paper include the effect of the thermal regime of river flows and reservoirs on the development of ice-forming processes, the main regularities of the formation of ice jams, the thickness of ice jams as a function of channel narrowing due to construction, high water levels caused by ice jams and ice dams, ice strength, passage of ice through partially constructed structure, regulation of ice conditions in the lower pools of hydrostations, and the thermal regime of reservoirs. Because a number of hydrostations are being planned, constructed, and operated in permafrost regions, it is necessary to greatly expand the study of the thermal regime of their reservoirs. (Keenan-IVI)
W85-06595

NIMBUS-7 SMMR POLARIZATION RESPONSES TO SNOW DEPTH IN THE MIDWESTERN U.S.,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
D. K. Hall, J. L. Foster, and A. T. C. Chang.
Nordic Hydrology, Vol. 15, No. 1, p 1-8, 1984. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Snow depth, *Microwave radiometry, *Satellite technology, Indiana, Brightness temperature, Remote sensing, Snowpack, Melting, Air temperature, Radiometry.

Analysis of January and February 1979 Scanning Multichannel Microwave Radiometer (SMMR) data has revealed discrepancies in the responses of vertically and horizontally polarized brightness temperature (TB) data to snow in the state of Indiana. Ten satellite overpasses were analyzed between January 8 and February 21, 1979. In four cases, the horizontally polarized TBS correlated with snow depth significantly better than did the vertically polarized TBS. These four overpasses occurred either when the snowpack was building up or when it had metamorphosed and/or was melting. For example, on February 17, the coefficient of correlation, R, between vertically polarized TB and snow depth was R = -.46 while it was R = -.86 for the horizontally polarized TB data. Just prior to February 17, air temperatures rose above 0 C in the study area causing melting of the snowpack. On February 17, air temperatures dropped well below 0 C and the snow and water in

the snowpack froze causing metamorphosis of the snowpack. It is concluded that horizontally polarized TB data may be more useful than vertically polarized data for analysis of snow in regions in which there are a range of snowpack conditions, or where a snowpack undergoes rapid metamorphosis. However, analysis of both polarizations may reveal information concerning the structure of a snowpack. (Author's abstract)
W85-06636

ROLE OF GROUND FROST, SNOW COVER, ICE BREAK-UP AND FLOODING IN THE FLUVIAL PROCESSES OF THE OULANKA RIVER, NE FINLAND,
Oulu Univ. (Finland). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W85-06806

GLACIATION DEVELOPMENT AND INTERSTADIAL SEA-LEVEL ON CENTRAL SPITSBERGEN, SVALBARD,
Bergen Univ. (Norway). Dept. of Geology.
J. Y. Landvik, and O. Salvigsen.
Polar Research, Vol. 3, No. 1, p 1-10, February, 1985. 6 Fig, 32 Ref.

Descriptors: *Glaciation, *Geology, *Sea level, *Spitsbergen, *Svalbard, *Norway, *Stratigraphy, Climatology, Sedimentology, Glaciers, Paleoclimatology.

A lithostratigraphical study at a site situated above the late glacial marine limit on central Spitsbergen (Norway) showed the development of at least two regional glaciations and an intermediate ice free period with a relatively high sea-level. A 20 m thick sequence of unconsolidated sediments occurs above the marine limit in Gangdalen, Nordenskiold Land. The top of the striated bedrock is composed of a 2 m thick till bed, a 15 m thick gravel interpreted to be deposited as a sandur, and another till bed on the top with a solifluction deposit capping the section. Fabric analyses and erratics in the two tills indicate a similar development in glacial transport directions during the two glaciations, starting with a local glaciation which subsequently turns into a larger glaciation centered over the eastern part of Svalbard. Co-existence of different ice domes over Spitsbergen is suggested by these observations. The sandur was deposited during an ice free period with a sea-level 40-80 m higher than at present but the section is undated. At present no glaciation of the entire Van Mijenfjorden area is dated. A firm correlation based on a high relative sea-level is impossible. (Collier-IVI)
W85-06843

2D. Evaporation and Transpiration

EVAPOTRANSPIRATION FROM PASTURE: A COMPARISON OF LYSIMETER AND BOWEN RATIO MEASUREMENTS WITH PRIESTLEY-TAYLOR ESTIMATES,
Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.
A. E. Green, B. E. Clothier, J. P. Kerr, and D. R. Scotter.
New Zealand Journal of Agricultural Research, Vol. 27, No. 3, p 321-327, 1984. 5 Fig, 17 Ref.

Descriptors: *Evapotranspiration, *Pastures, *Lysimeters, *Bowen Ratio, Energy balance, Soil heat flux, Air temperature, Estimation, Priestley-Taylor estimates.

The objectives of this study were to compare evapotranspiration (ET) data obtained using 2 independent measurement techniques, and to compare measured ET with ET estimates obtained using a commonly-applied formula. The measurements were made in a mixed-pasture paddock near Palmerston North (New Zealand). The soil, Manawatu fine sandy loam, contained adequate plant-available water during the study. One set of ET measurements was made using a weighing lysimeter with surface area 2 sq m and a soil depth of 1 m. The lysimeter had a suction-operated drainage system as its base. The other set of ET data was obtained using the Bowen ratio-energy balance technique, with duplicate sets of Bowen ratio apparatus, net radiometers, and soil heat flux sensors. Daily ET estimates were made with the Priestley-Taylor formula, using measured net radiation and air temperature values. The daily ET for well-watered, full-cover pasture measured by the lysimeter on rain-free days was in good agreement with the ET measured using the Bowen ratio-energy balance technique. The cumulative ET values over 35 such days differed by only 6%. When wet days were included in the comparson, larger discrepancies occurred. Over periods of less than a day there were sometimes quite large differences between the Bowen ratio and lysimeter ET measurements. Daily measurements of ET by the lysimeter agreed resonably well with Priestley-Taylor estimates; the agreement was even better over longer periods. The cumulative Priestly-Taylor ET value was 7% higher than the lysimeter ET values over 33 rain-free days. The estimated ET was 2% lower than the ET measured using the Bowen ratio method accumulated over 60 days. This agreement further confirms the usefulness of Priestly-Taylor estimates of ET from well-watered pasture in humid temperate climates. (Author's abstracts)
W85-06182

LUXURY WATER USE BY BERMUDAGRASS TURF,
Arizona Univ., Tucson. Coll. of Agriculture.
W. R. Kneebone, and I. L. Pepper.
Agronomy Journal, Vol. 76, p 999-1002, November-December, 1984. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Water use, *Grasses, *Bermudagrass, Evapotranspiration, Evaporation, Irrigation, Evaporative demand.

Use of luxury water by bermudagrass was investigated and the effect of high application rate on evapotranspiration (ET) was considered. The effects of three high irrigation levels (114, 243, and 364 mm/7 days) on evapotranspiration from seeded certified bergumagrass turf growing on three sand-soil substrates mixed with Pima clay loam were measured. The highest application rate on the two finest textured sand-soil mixes gave no significant increase in ET over that from the medium application level. Fluctuations in evapotranspiration paralleled evaporative demand, but the ratios of evapotranspiration to evaporative demand were higher during the low demand periods of winter and spring. Luxury use implies consumption far beyond need. In the past excessive watering was recognized as a waste of irrigation water lost by deep percolation and by surface runoff. These data show that with sufficient indulgence the turf itself can become a luxury user, and ET losses from bermudagrass turf can exceed pan evaporation by a considerable amount. (Baker-IVI)
W85-06189

EVAPORATION FROM EUCALYPTS GROWING IN A WEIGHING LYSIMETER: A TEST OF THE COMBINATION EQUATIONS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
A. R. Aston.
Agricultural and Forest Meteorology, Vol. 31, No. 3/4, p 241-249, June, 1984. 5 Fig, 13 Ref.

Descriptors: *Evaporation, *Plant growth, *Eucalypts, Evapotranspiration, Mathematical equations, Lysimeters, Forested watershed, Water loss, Leaves.

The combination equations for estimating evapotranspiration were tested using data obtained from a young eucalypt community growing in a weighing lysimeter. Measurements over a nine day period revealed discrepancies between observations and predictions during the morning. Significant improvement was obtained after the incorporation of an effective leaf area index rather than the measured leaf area index (LAI). The effective LAI was shown to change throughout the day and it is suggested that the changes were due to the particular distributions of trees and foliage around the study area and reflect the effect of changes in the solar radiation distribution through the canopy. (Baker-IVI)
W85-06191

WATER USE BY TAMARILLOS (CYPHOMANDRA BETACEA) WITHIN A SHELTERED ORCHARD ENVIRONMENT,
Ruakura Soil and Plant Research Station, Hamilton (New Zealand).
For primary bibliographic entry see Field 2I.
W85-06195

EVALUATION OF CANOPY TEMPERATURE-EVAPOTRANSPIRATION MODELS OVER VARIOUS CROPS,
Agricultural Research Service, Lubbock, TX. Plant Stress and Water Conservation Research Unit.
J. L. Hatfield, R. J. Reginato, and S. B. Idso.
Agricultural and Forest Meteorology, Vol. 32, No. 1, p 41-53, July, 1984. 10 Fig, 1 Tab, 20 Ref.

Descriptors: *Evapotranspiration, *Canopy temperature, Rainfall, Evaporation, Model studies, Air temperature, Energy balance, Crop production, Mathematical equations.

Evapotranspiration from a surface is a component of the partitioning of evergy received by that surface. Canopy temperature as an input to surface energy balance models provides a method for estimating actual evapotranspiration from a surface. Inclusion of canopy temperature with other meteorological data does not make a complete remote sensing approach but it does allow for dynamic coupling between the plant and atmosphere. Ground based net radiation, air temperature and windspeed are still needed as model inputs. Any collection of surface temperature from an air or spacecraft would represent an instantaneous evapotranspiration rate and this technique would have to be applied over a complete day to improve the utility of the information for agricultural management. (Baker-IVI)
W85-06196

SOIL SURFACE PSYCHROMETER FOR MEASURING HUMIDITY AND STUDYING EVAPORATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 7B.
W85-06197

STABILITY OF NON-WATER-STRESSED BASELINES,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
S. B. Idso, R. J. Reginato, K. L. Clawson, and M. G. Anderson.
Agricultural and Forest Meteorology, Vol. 32, No. 2, p 177-182, August, 1984. 4 Fig, 12 Ref.

Descriptors: *Water stress, *Vapor pressure, *Air temperature, *Leaves, Temperature effects, Plant growth, Wheat, Water hyacinth, Aquatic plants, Plant morphology.

Non-water-stressed baselines, plots of foliage-air temperature differential vs. air vapor pressure deficit, were obtained for seven different varieties of wheat and on a variety of water hyacinth having three different characteristic leaf sizes in experiments conducted at Phoenix, Arizona. The baseline of a species appears to be impressively stable if there are not large morphological differences among the varieties of that species. On the other hand, based on studies of a single variety of water hyacinth, the non-water-stressed baseline of a species can be dramatically dependent on leaf size. There is some evidence that aquatic plants may exhibit more variability in this regard than terrestrial plants. Thus more work needs to be done on terrestrial plants which can produce a wide range of leaf sizes within a single variety before a general statement can be made on this subject. (Baker-IVI)
W85-06198

PORTABLE EVAPORIMETER FOR RAPID MEASUREMENT OF THE EVAPORATION RATE OF WATER,
RCA Labs., Princeton, NJ.
R. Williams, A. Zangvil, and A. Karnieli.
Agricultural and Forest Meteorology, Vol. 32, No. 3/4, p 217-224, September, 1984. 5 Fig, 1 Tab, 8 Ref.

Descriptors: *Evaporation, *Measuring instruments, *Evaporimeter, Agriculture, Water loss, Evapotranspiration.

A new portable evaporimeter has been developed and tested. The instrument consists of precision-bore glass capillary tubing joined to a round plate. Ordinary laboratory filter paper saturated with water is placed on the plate. As water evaporates from the paper's surface it draws water up from the capillary to replace it. The motion of the meniscus is then equal to the linear evaporation rate multiplied by the ratio of the surface area of the paper to the area of the capillary. Field experiments have been carried out to compare measurements of the new instrument with those of the Class-A evaporation pan. A high correlation has been found between the two instruments. The scatter of the points of 20 experiments is quite large mainly because of the difference in the size and construction of the two instruments. From field experiments it is concluded that fairly reliable estimates of the Class-A Pan evaporation can be obtained rapidly with the new portable instrument. This is important as in many applications the Class-A Pan evaporation rate is used as a standard. A method is also presented to use measurements of the new evaporimeter to estimate the potential evapotranspiration. In this method the instrument is used to obtain an estimate of the net radiation needed in the Penman equation for evapotranspiration in the absence of radiation data. (Baker-IVI)
W85-06199

MICROCLIMATE CONTROL OF FOREST PRODUCTIVITY: ANALYSIS BY COMPUTER SIMULATION OF ANNUAL PHOTOSYNTHESIS/TRANSPIRATION BALANCE IN DIFFERENT ENVIRONMENTS,
Montana Univ., Missoula. School of Forestry.
S. W. Running.
Agricultural and Forest Meteorology, Vol. 32, No. 3/4, p 267-288, September, 1984. 9 Fig, 2 Tab, 55 Ref.

Descriptors: *Model studies, *Forests, *Photosynthesis, *Transpiration, *Microclimate, Productivity, Conifers, Carbon dioxide, Seasonal variation, Computers, Simulation, Climate, Precipitation, Montana.

A simulation model combining photosynthesis and transpiration for coniferous trees, DAYTRANS/PSN, was used to explore carbon dioxide and water exchange efficiencies under different seasonal climatic conditions. The simulation model first evaluated an eight month photosynthetic season using measured meteorological data from a western Montana site. Elevation, slope, aspect, and region-related variations in precipitation, incoming shortwave radiation, and air temperature were then programmed into the meteorological data set and the model re-run a total of 42 times. The model calculations correctly predicted the patterns of forest productivity seen in mountains of the western United States, whereas north slopes and higher elevations are more productive in water limited Montana, low elevations and south slopes become more productive in ecosystems that are energy limited. The absolute magnitudes of annual photosynthesis (PSN) calculated are only reasonable for this hypothetical tree. The microclimates used to run the model, while reasonable, were fabricated. An annual PSN budget ignores the complexities of carbon allocation, potential for leaf area reduction, the realities of insect consumption, stand crowding, wind damage and other factors that are part of the stands seen. Calculation of annual PSN generalized for a young healthy tree may provide a useful measure of site quality, the term used for site productive potential in forestry. By generalizing tree size and age, the temporary influence of current stand condition could be eliminated, allowing biophysically based definition of site productive potential that could ultimately be mapped over large areas. (Baker-IVI)
W85-06201

QUANTIFYING EFFECTS OF ATMOSPHERIC CO2 ENRICHMENT ON STOMATAL CONDUCTANCE AND EVAPOTRANSPIRATION OF WATER HYACINTH VIA INFRARED THERMOMETRY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
S. B. Idso, B. A. Kimball, and K. L. Clawson.
Agricultural and Forest Meteorology, Vol. 33, No. 1, p 15-22, November, 1984. 4 Fig, 19 Ref.

Descriptors: *Evapotranspiration, *Carbon dioxide, *Stomatal conductance, *Water hyacinth, Infrared imagery, Thermometry, Water stress, Leaves, Temperature, Aquatic plants.

Stomatal conductance and evaporative water loss were determined for two tanks of water hyacinths, one under ambient conditions and one considerably enriched in atmospheric carbon dioxide. The reduction in stomatal conductance was very dramatic for initial increases in carbon dioxide concentration, as the mean mid-day conductance fell to 50% of its ambient condition value at a carbon dioxide concentration of only 550 ppm. The effects of atmospheric carbon dioxide enrichment on evapotranspiration of water hyacinth show that the greatest reduction in evaporative water loss occurred initially and the relationship defined by the data appears to be internally consistent all the way out to a carbon dioxide concentration of 1800 ppm. Reduction in actual water loss was not as great as the reduction in stomatal conductance, for as the stomates began to close in response to increasing carbon dioxide and the transpiration rate began to be reduced, leaf temperatures rose in response to reduced evaporative cooling, resulting in an increased leaf-air vapor pressure gradient. The consequent negative feedback thus tended to counteract the effect of decreasing stomatal conductance. The stomatal response to increasing atmospheric carbon dioxide was identical to that induced by removing water from the plant roots, and the reduction in evaporative water loss with increasing atmospheric carbon dioxide was an inverse linear function of the plant water stress index, both of which phenomena had previously been theorized but never before experimentally verified. (Baker-IVI)
W85-06202

DIURNAL CHANGES IN THE INSTANTANEOUS WATER USE EFFICIENCY OF A SOYBEAN CROP,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
B. Zur, and J. W. Jones.
Agricultural and Forest Meteorology, Vol. 33, No. 1, p 41-51, November, 1984. 4 Fig, 14 Ref.

Descriptors: *Diurnal variation, *Soybeans, *Water use efficiency, Transpiration, Soybeans, Water stress, Vapor pressure deficit, Photosynthesis, Irrigation effects, Climate.

Variations in the instantaneous transpirational water use efficiency for a soybean crop were evaluated as affected by time of day, water stress, and vapor pressure deficit (VPD). Canopy transpiration (TR) and photosynthesis (CER) rates were measured hourly during five days of a nine-day soybean field experiment. One treatment was subjected to a drying cycle and one treatment was well-irrigated during the nine-day period. Instantaneous water use efficiency (WUE-i) was calculated by dividing canopy CER by TR for each hourly measurement. The plant may have no means of controlling its instantaneous transpirational water use efficiency. Instantaneous WUE-i of the soybean decreased during water stress as stomatal resistance increased and transpiration decreased. It is quite probable that the concept of water use efficiency so important in agriculture is of no significance to the crop itself. It is doubtful whether seasonal WUE has any physiological justification. Representing the wide range of climatological conditions during a growing season by one number has no theoretical basis. In addition, results from this study and from other studies showed that there exists a wide range of climatic conditions where the changes in CER and TR may be essentially independent of each other. (Baker-IVI)
W85-06203

RELATIONS BETWEEN AVAILABLE AND EXTRACTABLE SOIL WATER AND EVAPOTRANSPIRATION FROM A BEAN CROP,
Lincoln Coll. (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W85-06279

WATER USE-YIELD RELATIONS FOR COWPEA AND MAIZE,
Ife Univ. (Nigeria). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W85-06281

MEASURED EVAPORATION IN HIGH RAINFALL AREAS, LEEWARD KO'OLAU RANGE, OAHU, HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
P. C. Ekern.
Technical Report No. 156, October 1983, 69 p, 18 Fig, 14 Tab, 41 Ref, 6 Append.

Descriptors: *Evaporation, *Pan evaporation, *On-site data collections, *Rainfall, Capillarity, Evaporimeters, Evaporation pans, *Local precipitation, *Rainfall-runoff relationships, Rainfall intensity, Precipitation, Forest hydrology, Pearl Harbor, Hawaii, Kipapa transect, Manoa transect, Oahu.

Pumpage from the Pearl Harbor groundwater basin provides two-thirds of the water for irrigation and urban needs of Oahu. Surface runoff from the entire watershed has been evaluated as 18 percent of the 74 inch/year annual rainfall. To assess the extent of storage withdrawal of this newly regulated Hawaiian groundwater basin, evaporation was measured along two transects across the leeward Ko'olau Range. An evaporating surface was made from a dark, porous carborundum stone, 6 inches in diameter, that was wetted by capillary rise from a plastic reservoir. This more nearly simulated evaporation from a wetted leaf than any open-pan evaporimeter might. Class A pan evaporation at five different sites was 0.6 the water loss from corresponding evaporimeters. Water use on the Kipapa transect was that predicted by the Priestly-Taylor relationship, while water use on the Mahoa transect exceeded that predicted with positive advection from the urban surroundings and probable subsidence of the air from the Ko'olau crest. Of the near-normal 1981 rainfall of 149 inches, runoff was 27 percent, evaporation 28 percent, and deep percolate 45 percent for the Kipapa watershed water balance. (Hawkins-Omniplan)
W85-06345

HEAT BALANCE COMPONENTS AND EVAPOTRANSPIRATION FROM A SEDGE-GRASS MARSH,
Ceskoslovenska Akademie Ved, Trebon. Dept. of Hydrobotany.
K. Priban, and J. P. Ondok.
Folia Geobotanica et Phytotaxonomica, Vol. 20, No. 1, p 41-56, 1985. 9 Fig, 2 Tab, 21 Ref.

Descriptors: *Heat balance, *Evapotranspiration, *Marshes, Seasonal variation, Radiation, Humidity, Wind, Plant growth, Czechoslovakia.

Daily course of heat balance components and evapotranspiration were computed from meteorological data recorded in a sedge-grass marsh in South Bohemia, Czechoslovakia. Evapotranspiration (E) was determined by three methods: direct tank measurements, the Bowen-ratio method and the aerodynamic method. The tank measurement generally gave higher values of evapotranspiration

than the other two methods. The evapotranspiration from the tank was higher, on the average, mainly when groundwater level was lower than the water level in the tanks. When the water level in the tanks was kept low the difference was slight. Evapotranspiration was highest in May and June, in the period of the intense stand growth. Most of the net radiation was used for evapotranspiration, less for the sensible heat flux and least for the ground heat flux. The daily course of evapotranspiration calculated by the aerodynamic method showed the strongest correlation with wind velocity, and that calculated by the Bowen-ratio method with both global and net radiation. (Baker-IVI)
W85-06370

EVAPOTRANSPIRATION OF THE FOREST IN THE AMAZON REGION (EVAPOTRANSPIRACAO DE FLORESTAS DA REGIAO AMAZONICA),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
A. de Oliveira Marques Filko, M. de Nazare Gols Ribeiro, and E. Salati.
Acta Amazonica, Vol. 13, No. 3-4, p 519-529, July, 1983. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Evapotranspiration, *Amazon, *Forests, Energy, Evaporation.

Amazonia's forest evapotranspiration was calculated through an equation proposed by Thom and Olivier (Thom, A.S. and Olivier, H.R., 1977, On Penman's equation for estimating regional evaporation. Quarterly J. R. Meteorological Society, 103: 345-357). The data are taken from nineteen Weather Stations distributed in the region. The contribution of the aerodynamic term in the composition of evapotranspiration was confirmed to be similar to the contribution of the term associated with energy budget. The averaged value of potential evapotranspiration was found to be 7 mm/day. (Author's abstract)
W85-06450

MEASUREMENT AND PREDICTION OF EVAPORATION FROM FORESTED AND AGRICULTURAL CATCHMENTS,
Institute of Hydrology, Wallingford (England).
J. B. Stewart.
Agricultural Water Management, Vol. 8, No. 1-3, p 1-28, January, 1984. 2 Fig, 7 Tab, 41 Ref.

Descriptors: *Evaporation, *Evapotranspiration, *Forests, *Cultivated land, *Western Australia, Water table, Vegetation, Saline seeps, Land use, Saline soils, Land management, Surface roughness, Radiational energy balance.

In the wheatbelt of Western Australia the replacement of native forest by annual agricultural crops resulted in a rise in the water table, and the formation of saline seepage. Since there is no evidence of a change in the input of precipitation to this area, it is thought that the rise in the water table is solely due to a decrease in evaporation as a result of the change in vegetation. In the climate of that area, vegetation could evaporate at much higher rates than occurs at present, either from the agricultural crops or from the native forest; introduction of such vegetation could therefore lower the water table and reduce saline seepages. To achieve a significant decrease in the height of the water table would require that either the replacement vegetation had a very high rate of evaporation or a large proportion of the agricultural area had to be converted to the new vegetation. Physical characteristics which affect evaporation include radiational energy balance and surface roughness. Agricultural crops are generally monocultures and are therefore biologically simpler than mixed vegetation. They are shallow rooting in the majority of cases. Though the ground cover of annual crops varies during their life span, for about 2/3 of the time they are growing they completely cover the ground. Forests are generally much more complex. The majority of forests have numerous species and are multi-storied. Methods of measuring evaporation are briefly reviewed and compared. Methods of measuring evaporation from large areas and over periods of years can only be used to determine the total evaporation, whereas physically based methods used for smaller areas and shorter periods can measure the individual evaporation components and provide a sound basis for prediction of evaporation. The Monteith-Penman equation is most suitable for predicting the effects of changes in land use management. (Moore-IVI)
W85-06666

MEASURING EVAPOTRANSPIRATION BY HYDROLOGICAL METHODS,
Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
J. W. Holmes.
Agricultural Water Management, Vol. 8, No. 1-3, p 29-40, January, 1984. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Evapotranspiration, *Hydrologic equation, *Measuring instruments, Water storage, Aquifers, Unsaturated zone, Precipitation, Stream discharge, Lysimeters, Material balance.

The measurement of evapotranspiration using the methods of micrometeorology requires a sophisticated application of advanced technology. The simpler alternatives, though they are not always less costly, are discussed, namely (1) precipitation-minus-stream discharge, (2) estimates of the changes of the water storages, either in the water table aquifer or in the unsaturated zone of the soil, (3) lysimeters, and (4) material balance methods. The accuracies attainable by these methods vary. The most precise estimate can be got from a well-designed, weighable lysimeter, but the representativeness of the exposure is always a worry for the experimenter. The least precise estimate, on a month-to-month basis, is afforded by the precipitation-minus-stream discharge method, but this method can give a good estimate of annual total evapotranspiration. The range of evapotranspiration rates probably spans 0.7 mm/d in mid-winter, on occasions, to 5 mm/d in late spring if the season is a wet one. For reasonable definition of these rates on a daily basis, one is looking for a method that is accurate to +/- 0.2 mm/d. Only the weighing lysimeter can achieve this. The other methods variously provide mean rates for periods of five days or longer. (Author's abstract)
W85-06667

EVAPOTRANSPIRATION FROM A EUCALYPTUS COMMUNITY,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma.
Agricultural Water Management, Vol. 8, No. 1-3, p 41-56, January, 1984. 3 Fig, 2 Tab, 37 Ref.

Descriptors: *Evapotranspiration, *Eucalyptus, *Western Australia, Interception, Canopy, Evaporation, Rainfall, Forests, Soil water deficit, Root distribution.

Large areas of Australian forests are dominated by various species of the genus Eucalyptus. In southern Australia, clearing of native eucalypts has caused serious deterioration in water quality and as a result salinization of water resources has become the most serious environmental problem in Western Australia. Components of water balance were measured for a jarrah-marri (Eucalyptus marginata, E. calophylla) catchment over a period of five years and evapotranspiration was calculated. The catchment is located in a 1100 mm/yr rainfall region near Collie, Western Australia. Over a period of five years, annual evapotranspiration from a Eucalyptus catchment was more than 70% of the annual precipitation. During rainy winter periods, evapotranspiration far exceeded the available radiant energy. Monthly evapotranspiration rates were up to three times that of pan evaporation. Such losses may be due to large interception and evaporation of intercepted water at a rate considerably higher than the potential rate from a dry canopy. Evapotranspiration continued through the summer. Water extraction patterns suggest that eucalypts extracted water from depths down to 6 m, creating soil water deficits of up to 450 mm, compared to a water deficit of < 150 mm under annual pasture, under similar conditions. Interception and water extraction from deep soil horizons are the major factors responsible for high rates of water loss from eucalypt communities. (Moore-IVI)
W85-06668

DETERMINATION OF THE EVAPOTRANSPIRATION OF E. REGNANS FORESTED CATCHMENTS USING HYDROLOGICAL MEASUREMENTS,
Melbourne and Metropolitan Board of Works (Australia).
R. J. Morgan, and P. J. O'Shaughnessy.
Agricultural Water Management, Vol. 8, No. 1-3, p 57-76, January, 1984. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Evapotranspiration, *Forested watersheds, *Hydrologic budget, *Victoria, *Australia, Catchments, Streamflow, Eucalyptus, Catchment area, Radiation index.

Water balance investigations were conducted in Eucalyptus regnans forested catchments in the North Maroondah and Coranderrk Experimental Areas, Victoria, Australia. For the North Maroondah experimental catchments, variation in radiation index was the most important factor in accounting for differences in catchment loss, which is used as a measure of actual evapotranspiration. For the nine typical regrowth catchments, variation in radiation index is found to account for 45% of the variation in catchment loss. Loss also tends to increase with basal area and stocking, but the relationships are not statistically significant. If a method of reducing stand density can be developed that results in a permanent structure similar to that of a naturally open forest then increases in streamflow of significance to water supply may result. The old growth group of catchments has a significantly lower loss than that from each of three groups of regrowth catchments. These differences can not be explained in terms of radiation input alone, and there is a significant relationship between annual catchment loss and stocking rate for the 11 catchments. The stocking rate parameter serves to characterize both the differences in age between old growth and regrowth forest and the differences in density within each age class. The decrease in streamflow which would result from conversion of an open old growth forest to a dense regrowth forest is of the order of 215 mm which is important from a water supply point of view. The old growth Coranderrk catchments lose more water than would be expected on the basis of the behavior of the North Maroondah catchments. These enhanced losses may be attributable to greater inputs of advected energy in the Coranderrk situation. (Baker-IVI)
W85-06669

TERMINOLOGY AND CONCEPTS IN NATURAL EVAPORATION,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
I. C. McIlroy.
Agricultural Water Management, Vol. 8, No. 1-3, p 77-98, January, 1984. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Water management, *Evaporation, *Agriculture, Water supply, Evapotranspiration, Precipitation, Runoff, Infiltration, Interception, Drainage, Percolation, Radiant energy.

A systematic unified set of terms, definitions and symbols are presented which are applicable in the area of evaporation. A physical discussion of the evaporative process is offered, employing as its main tools the principal formulae used in evaporation measurement. The latter are tabulated using recommended terminology. For maximum insight into evaporative behavior under varying circumstances, attention is focussed on the combination method formulae, which are used to create a general picture of the interactions between evaporation and the many other factors which influence it. Specific topics discussed as part of the evaporative process include available water supply, surface energy supply, and vapor flow through the atmosphere. (Baker-IVI)
W85-06670

MEASUREMENT OF EVAPORATION BY METEOROLOGICAL METHODS,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
J. R. Garratt.
Agricultural Water Management, Vol. 8, No. 1-3, p 99-117, January, 1984. 3 Fig, 2 Tab, 50 Ref.

Descriptors: *Evaporation, *Energy budget, *Turbulent transfer, Forests, Canopy, Heat storage, Air temperature, Humidity, Surface resistance, Surface temperature, Eddy covariance, Wind.

Three methods based on energy budget and turbulent transfer formulations may be recommended for the determination of evaporation E from catchment areas. They all involve measurement of available energy R-G, R being net radiative flux and G the heat flux into the surface. When estimates from forests on an hourly to daily basis are made, the contribution from canopy heat storage should be included in G. The energy budget/Bowen ratio method requires no detailed specification of surface properties but involves relatively complex instrumentation to measure vertical differences of temperature and humidity in the air. Wtih the exclusion of eddy covariance, it is potentially the most accurate method and should be applicable for crops and forests, over a wide range of evaporation conditions. The residual energy budget method requires accurate estimates of atmospheric resistance and measurement of surface temperature. Where the latter is available (by airborne radiometer) the method is most reliable for surfaces of low roughness or in conditions of high evaporation. The combination method incorporates both energy budget and bulk relationships to eliminate surface temperature. It introduces surface resistance, which must be parameterized in terms of soil, plant species and atmospheric quantities, with allowance made for sub-canopy fluxes and evaporation of intercepted rainfall. The method is suitable for estimating daily or monthly evaporation using standard atmospheric observations. The eddy covariance method is not yet sufficiently developed to measure E reliably at the operational level over long periods of time and over less-than uniform terrain but, of all the methods to be described, it has the greatest potential to do so. Methods based on eddy covariance, wind and other profiles are more appropriate to research investigations. (Author's abstract)
W85-06671

EVAPOTRANSPIRATION - HOW GOOD IS THE BOWEN RATIO METHOD,
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
D. E. Angus, and P. J. Watts.
Agricultural Water Management, Vol. 8, No. 1-3, p 133-150, January, 1984. 66 Fig, 9 Ref.

Descriptors: *Evapotranspiration, *Bowen ratio method, Error analysis, Boundary conditions, Energy balance, Heat flux, Vapor pressure, Vegetation.

Under moist conditions, the energy balance approach to determining evapotranspiration from plant communities can give good results, but the method may not be nearly so accurate under very dry conditions, or with considerable advection of energy in moist conditions. In the former case, error analysis shows that the relative error in evapotranspiration can only be kept small provided that the relative error in the Bowen ratio is likewise small. In dry conditions, however, the absolute error in evapotranspiration is always fairly small, because of the small value of evapotranspiration itself. Analysis of the effect on the Bowen ratio of errors in the dry- and wet-bulb temperature gradients shows that in very dry conditions the required accuracy in the measurement of these gradients is an order of magnitude greater than could reasonably be expected for most Bowen ratio equipment. In the latter case, experimental results show that Bowen ratio measurements considered to be made, within the boundary layer, can give by day too small a value of evapotranspiration, and by night a latent heat flux direction which is inconsistent with the direction of the vapor pressure gradient. This raises the question as to what exactly is meant by adjustment of atmospheric properties to those of a new underlying surface when air passes over a boundary between two types of surface. (Author's abstract)
W85-06672

EVALUATION OF EVAPOTRANSPIRATION AND CANOPY RESISTANCE: AN ALTERNATIVE COMBINATION APPROACH,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
E. K. Webb.
Agricultural Water Management, Vol. 8, No. 1-3, p 151-166, January, 1984. 3 Fig, 1 Tab, 49 Ref.

Descriptors: *Evapotranspiration, *Canopy, *Surface resistance, Vegetation, Bowen ratio method, Penman-Monteith method, Aerodynamic properties, Heat budget, Surface temperature, Humidity.

This paper gives a preliminary outline of a suggested different type of combination method for evaluating evapotranspiration and surface resistance, with brief discussion of its application to vegetated surfaces. In the well known Penman-Monteith (P-M) combination method the surface temperature and humidity are eliminated by combining the bulk aerodynamic and heat budget relationships. In the method proposed the surface values are again eliminated, but by combining the bulk aerodynamic and Bowen ratio relationships (the B-B method). Whereas the P-M method may be applied using climatological data alone if desired, the B-B method is applicable only when the appropriate measurements are made including the Bowen ratio. The B-B method may be applied over short time intervals (e.g. 20 min) if required. The B-B formulation is more sensitive to the surface characteristics, bulk transfer coefficient and effective surface resistance, than is the P-M. Therefore it is suggested that for vegetated surfaces the main application of the B-B method would be in establishing empirically these surface characteristics for various types of vegetation at different stages of growth and under different conditions. In this role the capability of evaluation over small time intervals would be advantageous in studies with changing conditions, e.g. with soil drying out, with evaporation from wet foliage, or with changing illumination. (Author's abstract)
W85-06673

PLANT PHYSIOLOGICAL METHODS FOR STUDYING EVAPOTRANSPIRATION: PROBLEMS OF TELLING THE FOREST FROM THE TREES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
O. T. Denmead.
Agricultural Water Management, Vol. 8, No. 1-3, p 167-189, January, 1984. 10 Fig, 1 Tab, 36 Ref.

Descriptors: *Evapotranspiration, *Plant physiology, *Reviews, Micrometeorology, Eddy correlation, Tracers, Isotopic tracers, Microclimate, Evaporation, Transpiration, Chamber methods, Soil evaporation, Litter.

This review is concerned with methods for quantifying physical and physiological processes within plant communities which influence evapotranspiration. Micrometeorological approaches have not been very fruitful because of their reliance on classical flux-gradient relationships, but new perceptions and eddy correlation techniques promise real progress in the near future. Alternative plant physiological approaches including chamber systems, tracer techniques and so-called combination methods, are considered. Perceived problems with chamber systems are the difficulties of mimicking the natural environment inside the chamber and the effects of chamber air pressure on vapor transfer from the soil. Tracer techniques (using pulses of heat or radioactive isotopes) avoid these problems but require exact knowledge of the water pathway in the stem. Combination methods also do not disturb the natural environment, but any difficult measurements are required and the sampling problems are large. They can be applied with least equivocation to layers of leaves. Application to whole plant communities is circumspect because of changing microclimates within the community, the large vertical spread of sources and sinks, and the fact that much of the evaporated water may not pass through plants at all. Many physiological approaches measure only transpiration. Some attention is given to the neglected component, soil evaporation. An analysis of evaporation from the floor of a pine forest suggests that the litter limits the vapor loss to perhaps half what it might be if the soil surface was exposed. (Author's abstract)
W85-06674

EVAPOTRANSPIRATION OF FOUR MAJOR AGRICULTURAL PLANT COMMUNITIES IN THE SOUTH-WEST OF WESTERN AUSTRALIA MEASURED WITH LARGE VENTILATED CHAMBERS,
Western Australia Dept. of Agriculture, South Perth. Div. of Resource Management.
R. A. Nulsen.
Agricultural Water Management, Vol. 8, No. 1-3, p 191-202, January, 1984. 5 Fig, 3 Tab, 11 Ref.

Descriptors: *Evapotranspiration, *Crops, *Western Australia, Ventilation chambers, Agronomic practices, Saline soils, Wheat, Barley, Lupin, Clover, Water use, Groundwater recharge.

Reduced evapotranspiration as a result of replacing perennial native vegetation with annual crops and pastures leads to secondary salinization of agricultural soils in the south-west of Western Australia. Manipulating agronomic practices may significantly reduce the recharge and thus retard or halt salting or even reclaim salt affected land. Ventilated chambers were used to measure evapotranspiration of four common agricultural species: wheat, barley, lupins and subterranean clover. There was a large variation between successive years, but the relative water consumption by the various species was consistent. A barley-lupins rotation reduced recharge by 50% compared with a wheat-clover rotation. The ventilated chamber technique has some limitations, even for the comparative measurement of evapotranspiration. A reliable estimate of velocity is essential, but four methods of velocity measurement were tested and agreement between the four was not good. This casts some doubt on the validity of the results in absolute terms but the data probably can still be used for comparative purposes. There appears to be a good chance that agronomic manipulation can reduce recharge to the groundwater system and eventually restrict the rate of secondary salinization in the cereal growing areas of Western Australia. Because the proposed changes lie within the present agricultural technology of the State, once the technique has been shown effective, the chances of adoption by the farming community would seem reasonable. (Moore-IVI)
W85-06675

MODELLING EVAPOTRANSPIRATION: AN APPROACH TO HETEROGENEOUS COMMUNITIES,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
C. W. Rose.
Agricultural Water Management, Vol. 8, No. 1-3, p 203-221, January, 1984. 4 Fig, 33 Ref.

Descriptors: *Evapotranspiration, *Mathematical models, Transpiration, Penman-Monteith equation, Trees, Wind, Water vapor, Evaporation, Canopy, Forests.

The paper considers how evapotranspiration from a heterogeneous community of trees might be modelled. Relevant literature is reviewed, including the Penman-Monteith equation. New theory is developed for predicting transpiration from an isolated tree, which recognized the ability of such a tree to extract energy from and add water to air flowing laterally through the canopy. In this theory a tree is divided into a top and bottom part, with the top part assumed to lose water vapor both vertically to air above the canopy and horizontally to air passing through canopy; the only form of

water vapor loss from the bottom part is assumed to be horizontal. The Penman-Monteith equation is applied to estimate the 'vertical' evaporation, and theory developed to estimate 'horizontal' evaporation which recognizes the limitation on water loss imposed by stomatal and boundary layer resistances. One conclusion which follows from this analysis is that transpiration from an isolated tree will in general be less dependent on wind speed than the modest dependence on wind speed of transpiration from a (dry) canopy. Other implications of the theory are investigated using a numerical example. The theory developed allows estimation of the ratio of the transpiration rate for an isolated tree to that of a tree with the same relevant characteristics exposed to a similar environment. This capability is used to provide a framework for considering transpiration for heterogeneous tree communities. (Author's abstract)
W85-06676

MODEL OF CANOPY DRYING,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
E. Wronski.
Agricultural Water Management, Vol. 8, No. 1-3, p 243-262, January, 1984. 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Canopy drying, *Mathematical models, *Pine trees, Forests, Diffusion, Interception, Evapotranspiration, Airflow, Transpiration, Stomatal resistance.

There is evidence that the enhanced evaporation of intercepted water from forests can significantly reduce water yield relative to short vegetation. As intercepted water evaporates, some simply replaces transpiration which would otherwise have occurred had the canopy been dry. A one-dimensional diffusion model of canopy drying applied to a Pinus radiata forest yielded evapotranspiration rates during canopy drying less than those observed. The discrepancy indicated either there was a substantially greater interchange between the above and within canopy airflow than calculated assuming local diffusion, or there was a reduction in stomatal resistance caused by low transpiration demand when the canopy was wet. Most transpiration from a Pinus radiata canopy occurs below the main radiation sink, in a zone in the canopy where processes are strongly governed by the turbulent interchange between the airflow within and above the canopy. The net interception loss associated with daytime canopy drying was approximately 60% of the interception loss. Part of this net loss may be due to a reduction in stomatal resistance during canopy drying, associated with low transpiration and humidity deficits at that time. (Moore-IVI)
W85-06678

EVAPOTRANSPIRATION AND SOIL HETEROGENEITY,
Oak Ridge National Lab., TN. Environmental Sciences Div.
R. J. Luxmoore, and M. L. Sharma.
Agricultural Water Management, Vol. 8, No. 1-3, p 279-289, January, 1984. 5 Fig, 4 Tab, 10 Ref.

Descriptors: *Evapotranspiration, *Soil texture, Pore size, Simulation, Mathematical models, Soil physical properties, Water potential, Stomatal conductance, Soil water capacity, Soil hydraulic properties.

Soil hydraulic properties are likely to affect evapotranspiration through their effect on water availability to plants. By using scaling theory, effects of soil spatial heterogeneity on evapotranspiration of a grassland catchment were simulated by the Terrestrial Ecosystem Hydrology Model (TEHM). Scaling theory provides a basis for expressing soil heterogeneity in terms of a single variable, the mean pore size of a soil. Annual evapotranspiration was predicted to increase up to 22% for soils with smaller mean pore size (finer textured) than the reference silty loam soil. Water potential and stomatal conductance of foliage were generally higher for finer textured soils. This increased water supply to vegetation was related to higher water capacity of soils with smaller pore sizes in this instance. The soils with high water capacity at matric potential below field capacity store more water during recharge and provide more available water to plants during dry periods than soils with lower water capacity. Sequences of wetting and drying cycles favor higher transpiration and lower drainage from soils with higher water capacity. Spatial variation in soil hydraulic properties could significantly influence areal evapotranspiration. (Moore-IVI)
W85-06679

DEVELOPMENT AND PROVING OF MODELS OF LARGE SCALE EVAPOTRANSPIRATION: AN AUSTRALIAN STUDY,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
F. X. Dunin, and A. R. Aston.
Agricultural Water Management, Vol. 8, No. 1-3, p 305-323, January, 1984. 6 Fig, 2 Tab, 21 Ref.

Descriptors: *Evapotranspiration, *Model studies, *Australia, Climate, Topography, Soil properties, Vegetation, Runoff, Transpiration, Soil water, Forests, Leaves, Roots, Computers.

Areal evapotranspiration from an experimental catchment and a river basin was estimated by model, which was initially developed for point values measured by a weighing lysimeter. Modifications to the model framework to accomodate scale effects of variability in climate, topography, soils and vegetation were outlined. Model performance was assessed with satisfactory agreement in monthly values between computed and measured evapotranspiration of the experimental catchment. At the river basin level, acceptable estimates of evapotranspiration were inferred on the basis of general agreement between computed and measured values of monthly runoff. Evaluation of model performance included a comparison of lysimeter measurements with computed values for the small experimental catchment. It was concluded that extrapolation of point measurements can be questionable even on a local scale and this finding strengthened the case for model determinations as being a realistic approach to estimate areal evapotranspiration. Discussion of model results explored the generality of model assumptions for scaling meteorological inputs and particularly for descriptions of transpiration response to soil water supply. The efficacy of single-curve expressions inherent in the model to explain transpiration rate as function of soil water content, was examined in the context of additional data from a weighing lysimeter of a young eucalypt forest community. Analysis of the eucalypt data indicated a complex response in transpiration behavior. Critical levels of soil water supply changed with atmospheric demand, and morphological interactions of leaf area and root development influenced rates of soil water extraction in modifying patterns of transpiration dynamics. Thus an extended application of the present model study of evapotranspiration, albeit with realistic results, demands a critical appraisal of the underlying model assumptions to assess their relevance for a different suite of conditions either in time or space. (Author's abstract)
W85-06681

CROP WATER REQUIREMENTS FOR RAINFED AND IRRIGATED WHEAT IN CHINA AND KOREA,
California Univ., Los Angeles. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W85-06687

EVAPORATION AND DRIFT LOSSES FROM SPRINKLER IRRIGATION SYSTEMS UNDER VARIOUS OPERATING CONDITIONS,
Cukurova Univ., Adana (Turkey). Coll. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W85-06689

SPECTRAL CHARACTERISTICS OF THE GLOBAL MOISTURE DISTRIBUTION AND THEIR IMPORTANCE IN OBJECTIVE ANALYSIS OF MOISTURE FOR NWP MODELS,
Systems and Applied Sciences Corp., Riverdale, MD.
D. C. Norquist, and C. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA 120397. Scientific Report No. 1. AFGL-TR-82-0190. July 14, 1982. 61 p. 31 Fig, 8 Tab. Contract/Grant No. F19628-82-C-0023.

Descriptors: *Specific humidity, *Weather forecasting, *Model studies, Moisture, Baseline studies, Prediction.

Using data sets of observations of atmospheric variables on a global scale, the spectral distribution of atmospheric moisture was compared with that of wind and mass fields. Results show that, spectrally, the wind field has more of its power in higher wave numbers, and temperature and geopotential height have more power in lower wave numbers than does moisture. Moisture has a shift in its power toward higher wave number with altitude, contrasting with a greater concentration of power in low wave numbers with altitude for geopotential. A baseline aqainst which objective analysis methods for the respective variables may be tested was established, to determine how accurately each method represents the observed field. It is concluded on the basis of the unique characteristics of the moisture spectrum that a mass-motion objective analysis scheme need to be modified to make it useful for moisture analysis or an entirely separate scheme needs to be developed for moisture analysis.
W85-06958

2E. Streamflow and Runoff

FLOOD-RUNOFF FORECASTING WITH HEC1F,
Hydrologic Engineering Center, Davis, CA.
J. C. Peters, and P. B. Ely.
Water Resources Bulletin, Vol. 21, No. 1, p 7-13, February, 1985. 9 Fig, 8 Ref.

Descriptors: *Flood forecasting, *Computers, *Runoff, Hydrographs, Rainfall-runoff relationships, Flood routing, Data processing, Streamflow, Reservoirs, Simulation.

HEC1F is a computer program for making short- to medium-term forecasts of uncontrolled flood runoff. The program employs unit hydrographs and hydrologic routing to simulate runoff from a subdivided basin. Estimates of future rainfall can be accommodated. Runoff parameters for gaged headwater subbasins can be estimated (optimized) in real time. Blending of calculated with observed hydrographs can be performed. HEC1F is a component of an on-line software system that includes capability for data acquisition and processing, precipitation analysis, streamflow forecasting, reservoir system analysis, and graphical display of data and simulation results. The conceptual framework for HEC1F is described, and application of the program is illustrated. (Author's abstract)
W85-06233

PLANNING FOR DROUGHT: THE ROLE OF STATE GOVERNMENT,
Nebraska Univ.-Lincoln. Inst. of Agriculture and Natural Resources.
For primary bibliographic entry see Field 6A.
W85-06236

EVOLUTION OF A DRAINAGE NETWORK: REMOTE SENSING ANALYSIS OF THE NORTH FORK TOUTLE RIVER, MOUNT ST. HELENS, WASHINGTON,
Oregon State Univ., Corvallis. Dept. of Geography.
C. L. Rosenfeld, and G. L. Beach.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 160679/AS, Price codes: A06 in paper copy, A01 in microfiche. Project Completion Report, Oregon Water Resources Research Institute, Corvallis, Publica-

tion WRRI-88, November 1983, 100 p, 21 Fig, 4 Tab, 10 Ref, 2 Append, Project No. BuRec C-100082-V (1), Contract/Grant No. 14-34-0001-1452.

Descriptors: *Drainage networks, *Drainage patterns, *Erosion, Channel erosion, Gully erosion, *Sedimentation, Sediment transport, Deposition, Mud flows, *Volcanoes, *Remote sensing, Mapping, *Geomorphology, *Mt. St. Helens, *Washington, *Toutle River.

The May 18, 1980 eruption of Mt. St. Helens and subsequent volcanic events caused a large debris avalanche and several smaller pyroclastic flows and mudflows in the upper North Fork Toutle River. Major hydrologic disruptions resulted because of the newly created landscape. Aerial surveillance, mapping and evaluation of hydrologic conditions in upper reaches of the North Fork Toutle River valley were conducted from October 1981 until January 1983. The rate and mode of erosional and depositional landscape development was assessed and the potential for additional catastrophic events was evaluated. Major drainage network development was observed and the geomorphic trends of this evolutionary development were studied. A series of six detailed interpretative hydrologic status maps were produced to study the locations, patterns, and densities of fluvial and geomorphic features as well the temporal and spatial changes. These maps also indicate the rates of channel network evolution. Significant hydrographic changes occurred following each storm event. Development and downward migration of gullies and streams progressed rapidly during winter 1981-1982; numerous outbreaks of ponds and lakes occurred. Channel aggradation and degradation occurred along the North Fork Toutle River during summer 1982. A series of high-intensity, long-duration storm events in February 1982 causes significant changes in drainage network evolution which culminated with the inundation of Jackson Lake, resulting in a flood surge downn-river and the failure of the spillway on the northern sediment retention dam.
W85-06303

PROBLEM ORIENTED EVALUATION OF INSTITUTIONAL DECISION MAKING AND IMPROVEMENT OF MODELS USED IN REGIONAL URBAN RUNOFF MANAGEMENT: APPLICATION TO INDIANA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6A.
W85-06306

STORMWATER MANAGEMENT ALTERNATIVES - A COMPUTER-BASED PROGRAM FOR THE SELECTION OF TECHNIQUES TO MITIGATE THE IMPACT OF URBAN STORMWATER,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
J. T. Tourbier.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157857/AS, Price codes: A07 in paper copy. Project Completion Report, 1984. 141 p, Project No. USGS G-833/23.

Descriptors: *Storm runoff, Management planning, *Computer models, Technology transfer, Planning, Urban runoff.

The purpose of this project was to develop a software program for use with an IBM Personal Computer as a technology transfer tool that aids in the selection of stormwater management techniques. Users are asked to supply information about a development site and define planning objectives. The program then quantifies runoff conditions. The program pre-selects measures applicable to the site. The user is then able to explore measures in various levels of detail and assign to a given measure a value representing its assumed usefulness. The user is then directed to eliminate measures that duplicate functions and reminded to explore applicable concepts and measures that have been overlooked. Finally, the program offers design, operation, and maintenance recommendations for measures selected and gives a printout of the information. The program may be used by planning commissions, engineering and public works departments, consulting firms, and universities.
W85-06328

EVIDENCE OF FLOODS ON THE POTOMAC RIVER FROM ANATOMICAL ABNORMALITIES IN THE WOOD OF FLOOD-PLAIN TREES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2I.
W85-06360

STRUCTURE AND ECOLOGY OF THE MICRO-FAUNA IN THE CENTRAL AMAZONIAN FOREST STREAM 'IGARAPE DA CACHOEIRA',
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
I. Walker.
Hydrobiologia, Vol. 122, No. 2, p 137-152, 1985. 11 Fig, 2 Tab, 37 Ref.

Descriptors: *Microfauna, *Streams, *Brazil, *Forest watersheds, Ecology, Sampling, Litter, Rainfall, Detritus, Fish, Bacteria, Algae, Biomass.

A special method was developed to sample the microfauna in open stream water and to observe its food habits over long periods in the laboratory. The microfauna is primarily associated with submerged leaf litter. Its density in the open water is a function of water current and hence, of rainfall. A considerable quantity of living and detritus biomass is swept downstream with each heavy rain. The foodweb starts essentially with decomposing fungi and detritus, and to a much lesser extent with algae and bacteria. Protozoa and Rhabdocoela are an insignificant input into the foodweb of higher invertebrates, but their role for maintenance of water quality may be important. Prey of fishes and shrimps depends primarily on primary input, i.e. on detritus, fungi and to some extent on algae and bacteria. The role of biomass transport from forest streams into large rivers is discussed in relation to the fauna of the periodically inundated forest. (Baker-IVI)
W85-06387

TIME-SERIES MODELS FOR THE PREDICTION OF STREAM FLOW IN A KARST DRAINAGE SYSTEM,
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
A. J. Jakeman, M. A. Greenaway, and J. N. Jennings.
Journal of Hydrology, Vol. 23, No. 1, p 21-33, 1984. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Time series analysis, *Streamflow, *Karst hydrology, *Drainage systems, *Cave Creek, *Cooleman Plain, *New Zealand, Rainfall, Model studies, Prediction.

Time series methods are used to predict values for numerous missing daily flow records from rainfall in the Cave Creek drainage system, Cooleman Plain, New South Wales. Separate models are developed which are statistically valid for fixed portions of the data. Missing flows within a consistently-behaved hydrological period can be predicted from the statistical model, which is identified from other data within the period. The method circumvents difficulties associated with validating a detailed physical model of a complex hydrological/geomorphological system. By regression with sample chemical analyses the discharge estimates obtained are used to ascertain the temporal distribution of limestone solution, which is the dominant geomorphic process here. (Author's abstract)
W85-06434

INFLUENCE OF WIND ON CURRENTS IN RIVER MOUTHS (O VLIYANII VETRA NA TECHENIYA V UST'YAKH REK),
S. A. Arsenev, and N. K. Shelkovnikov.
Okeanologiya, Vol. 24, No. 2, p 263-269, March/April, 1984. 4 Fig, 21 Ref.

Descriptors: *Wind-driven currents, *River flow, *River mouth, *Volga River, *Hudson River, Water currents, Wind, Wind velocity, Rivers, Bottom currents.

The influence of wind on currents in well-mixed river mouths was investigated. The surge-ebb winds are shown to generate bottom currents directed to and from river mouths. The theory explains the observations made in the Volga and Hudson River mouths. (Author's abstract)
W85-06455

MULTISITE ARMA (1,1) AND DISAGGREGATION MODELS FOR ANNUAL STREAMFLOW GENERATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, D. P. Lettenmaier, and R. M. Vogel.
Water Resources Research, Vol. 21, No. 4, p 497-509, April, 1985. 4 Fig, 9 Tab, 35 Ref, 1 Append. NSF grants CME 8010889 and CEE 8211730.

Descriptors: *Streamflow, *Autoregressive moving average models, *Disaggregation models, *Time series analysis, Mathematical models, Model studies, Algorithms.

Disaggregation and multisite autoregressive moving average (ARMA)(1,1) time-series models provide simple and efficient frameworks for generation of multisite synthetic streamflow sequences that exhibit long-term persistence. This paper considers multisite ARMA(1,1) models whose Phi and Theta matrices are diagonal; a Monte Carlo study examined the efficiency of three procedures for estimating individual phi-theta values for each site and two estimators of the covariance matrix of the innovations. Also included in the study was a univariate ARMA(1,1) model of the aggregate flows with a simple disaggregation algorithm to generate flows at the individual sites. In the realm of most hydrologic interest, simple diagonal multisite ARMA(1,1) models performed adequately and it is not necessary to fit more cumbersome nondiagonal models. The disaggregation procedure coupled with an ARMA(1,1) aggregate flow model did as well as the multivariate diagonal ARMA(1,1) models. (Author's abstract)
W85-06504

STOCHASTIC STREAMFLOW MODEL BASED ON PHYSICAL PRINCIPLES,
Portland State Univ., OR. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W85-06508

EFFECT OF GLACIERS ON STREAMFLOW VARIATIONS,
Geological Survey, Tacoma, WA.
A. G. Fountain, and W. V. Tangborn.
Water Resources Research, Vol. 21, No. 4, p 579-586, April, 1985. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Glaciers, *Melting, *Streamflow, *Cascade Mountains, *Washington, *Glaciohydrology, Hydrologic cycle, Seasonal variation, Meltwater, Englacial storage, Runoff, Algorithms.

Glaciers are frozen reservoirs of water. The release of water from storage greatly affects the local hydrological cycle by contributing to streamflow in otherwise low flow periods. The effect of temperate glaciers on runoff variations is examined for the North Cascade Mountains of Washington State. The principal influences of glaciers on streamflow are often unexpected contributions to streamflow volume, a delay of the maximum seasonal flow, and a decrease in annual and monthly variation of runoff. The delay of maximum flow is caused by temporary englacial storage of spring meltwater and by peak meltwater production occurring in midsummer. The englacial storage, for one case, is 54% of the potential May runoff. An

algorithm is presented that calculates the coefficient of variation of runoff for any arbitrary glacier cover. A minimum in year-to-year variation may occur for basins about 36% glacierized. The variations then increases with increasing glacerization to 100% glacier cover, at which point the variation is almost equal to that of a nonglacierized basin. The monthly runoff variations show a minimum in April through May for unglacierized basins, and a maximum in March and April for basins 100% glacierized. The minimum is caused by snowmelt compensating for rainfall variations in unglacerized basins, and the maximum, if not an artifact of the analysis, may be caused by irregular water storage in the glacier, resulting in a greater variation in runoff from highly glacierized basins. The minimum coefficient of variation occurs in July, August, and September, when icemelt compensates for deviations in precipitation, and appears for basins with more than about 10% cover. (Moore-IVI)
W85-06512

WATER BALANCE MODELS IN ONE-MONTH-AHEAD STREAMFLOW FORECASTING,
Geological Survey, Reston, VA.
W. M. Alley.
Water Resources Research, Vol. 21, No. 4, p 597-606, April, 1985. 3 Fig, 8 Tab, 25 Ref.

Descriptors: *Hydrologic budget, *Streamflow forecasting, *New Jersey, Seasonal variation, Mathematical models, Time series analysis, Autoregressive models, Forecasting.

Techniques are tested that incorporate information from water balance models in making 1-month-ahead streamflow forecasts in New Jersey. The results are compared to those based on simple autoregressive time series models. The relative performance of the models is dependent on the month of the year in question. The water balance models are most useful for forecasts of April and May flows. For the stations in northern New Jersey, the April and May forecasts were made in order of decreasing reliability using the water-balance-based approaches, using the historical monthly means, and using simple autoregressive models. The water balance models were useful to a lesser extent for forecasts during the fall months. For the rest of the year the improvements in forecasts over those obtained using the simpler autoregressive models were either very small or the simpler models provided better forecasts. When using the water balance models, monthly corrections for bias are found to improve minimum mean-square-error forecasts as well as to improve estimates of the forecasts conditional distributions. (Author's abstract)
W85-06514

RESPONSE OF ALLUVIAL RIVERS TO SLOW ACTIVE TECTONIC MOVEMENT,
Chuo Univ., Tokyo (Japan). Inst. of Geosciences.
For primary bibliographic entry see Field 2J.
W85-06517

DRAINAGE INITIATION BY SUBSURFACE FLOW IN SOUTH TARANAKI, NEW ZEALAND,
Victoria Univ., Wellington (New Zealand). Dept. of Geology.
B. Pillans.
Geology, Vol. 13, No. 4, p 262-265, April, 1985. 3 Fig, 16 Ref.

Descriptors: *Storm seepage, *Drainage initiation, *South Taranaki, *New Zealand, Sapping, Subaerial drainage networks, Bifurcation, Streams, Fluvial processes.

The elevation of new land along an actively rising coastline has been recognized as an initial surface upon which subaerial drainage networks are formed. The South Taranaki coastal plain between Hawera and Wanganui in the North Island of New Zealand represents such an initial surface in the early stages of its evolution. A broad flight of upper Quaternary marine terraces is being progressively dissected by fluvial processes. Small terrace-front valleys as long as 1 km are initiated and lengthened by headward sapping. The process is largely controlled by subsurface flow in permeable terrace cover beds overlying impermeable Tertiary mudstones and siltstones. The gentle, seaward dip of wave-cut surfaces results in dominantly shore-normal (consequent) streams in the early stages of drainage-network evolution. Network growth (bifurcation) is also largely controlled by subsurface flow and may explain why many stream junctions in South Taranaki are roughly orthogonal. A point is eventually reached when a terrace surface becomes completely dissected and drainage networks must evolve by different mechanisms. There are fundamental differences between the mechanisms of drainage-network development in the early and later stages of landscape evolution in South Taranaki; an early stage characterized by headward retreat through sapping and a later stage characterized by its absence or a near absence. (Author's abstract)
W85-06520

EFFECT OF CLUSTERING OF FLOOD PEAKS ON A FLOOD RISK ANALYSIS FOR THE RED RIVER,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
C. Booy, and D. R. Morgan.
Canadian Journal of Civil Engineering, Vol. 12, No. 1, p 150-165, March, 1985. 15 Fig, 5 Tab, 14 Ref.

Descriptors: *Flood forecasting, *Flood peak, *Red River, *Winnipeg, *Manitoba, Risks, Flood frequency, Bayesian probability distribution, Time series, Estimating.

The record of annual flood peaks on the Red River at Redwood Bridge in Winnipeg, Manitoba shows a degree of clustering of high flood years that, statistically speaking, is incompatible with the customary assumption of serial independence in flood frequency analysis. Additional evidence of a circumstantial nature has been adduced to further substantiate the observed clustering. Clustering affects the weight that must be given to the historical floods in the flood risk analysis, in particular the 1826 and 1852 floods, which were considerably in excess of the maximum recorded flood. Bayesian updating of the information obtained from the record with the information supplied by the historical floods shows that clustering leads to a substantially increased flood risk for the City of Winnipeg and the towns and villages in the Red River Valley. (Baker-IVI)
W85-06553

EXTREME VALUE PROCESSES AND THE EVALUATION OF RISK IN FLOOD ANALYSIS,
Universitaet fuer Bodenkultur, Vienna (Austria). Inst. fuer Mathematik and Angewandte Statistik.
F. Konecny, and H. P. Nachtnebel.
Applied Mathematical Modelling, Vol. 9, No. 1, p 11-15, February, 1985. 1 Fig, 12 Ref.

Descriptors: *Flood flow, *Risk analysis, *Predicting, Floods, Stochastic process, Model studies, Flood peak, Seasonal variation, Temporal distribution.

An analysis of hydrological risk is presented associated with decisions based on stochastic flood models. The maxima of a stream-flow are described by a marked Poisson process with a cyclic trend and exponentially distributed marks. Typical design criteria like the expected larger exceedance of a fixed level in a given period are derived from the extreme value process. The proposed model has been applied to a discharge series of 86 years (1893-1978) observed at the gauging station Pegel Federaun which is located at the river Gail in Carinthia, Southern Austria. After selecting a base level such that it was surmounted approximately once a year, 243 flood peaks were observed. Both the intensity function and the distribution of the exceedances are strongly dependent on seasonal influences. The exceedances are not identically distributed, but follow a distribution dependent on the occurrence time. Risk analysis on the basis of a large partial duration series can be performed quite easily using the asymptotic distribution of the design exceedance. (Baker-IVI)
W85-06561

CHARACTERISTICS OF THE HYDROLOGY OF SIBERIAN RIVERS BASED ON EXPERIENCE IN THE DESIGN AND CONSTRUCTION OF HYDROELECTRIC STATIONS,
For primary bibliographic entry see Field 2C.
W85-06595

APPLICATION OF A CELL MODEL TO THE BELLEBEEK WATERSHED,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
M. H. Diskin, G. Wyseure, and J. Feyen.
Nordic Hydrology, Vol. 15, No. 1. p 25-38, 1984. 9 Fig, 2 Tab, 9 Ref.

Descriptors: *Bellebeek watershed, *Belgium, *Cell model, *Runoff, Rainfall-runoff relationships, Model studies, Routing models, Simulation, Storms.

A new version of a semi-distributed routing model has been applied to the Bellebeek watershed in Belgium, where runoff data were available for a number of internal gauging stations in addition to the outlet runoff data. The new version has provisions for separately routing the rainfall excess input and the channel inflow input to each unit of area represented in the model by a cell. The cells are interconnected in a tree-like structure reflecting the main drainage pattern of the watershed. The semi-distributed nature of the model makes it possible to simulate spatially variable rainfalls or moving storms. The cell model was calibrated by adjusting its three parameters to reproduce, as nearly as possible, the outflow at the main gauging station of the watershed. The direct surface runoff hydrographs for internal points of the model were then compared to the measured runoff at the internal gauging stations. (Author's abstract)
W85-06638

HYDROLOGICAL DATA-MODEL WORK IN GREENLAND,
Greenland Technical Organization, Copenhagen (Denmark).
For primary bibliographic entry see Field 2A.
W85-06639

INVESTIGATION OF THE INFLUENCE OF RAINFALL MOVEMENT ON RUNOFF HYDROGRAPH. PART I - SIMULATION ON CONCEPTUAL CATCHMENT,
Lund Univ. (Sweden).
J. Niemczynowicz.
Nordic Hydrology, Vol. 15, No. 2, p 57-70. 1984. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Rainfall, *Hydrographs, *Runoff, *Simulation, *Rainfall-runoff relationships, Catchments, Storms, Directional bias, Velocity, Storm runoff, Discharge.

Studies are described which were performed on a conceptual catchment in efforts to find the general shape of the relation between storm movement parameters like storm duration, intensity, velocity and direction, and its influence on peak discharge. This influence is called a directional bias. Different factors affecting the magnitude of directional bias are described. The relations between rainfall characteristics and the magnitude of the directional bias are shown for a conceptual catchment. The maximal directional bias can be expected for storms moving downstream the catchment with velocity equal to the average flow velocity. The maximal directional bias can reach values of several hundred percent, but this occurs for storms with short duration and has no practical importance. For storms with velocity under the average flow velocity the maximal directional bias decreases with increasing return period. For storms with velocity above the average flow velocity, the maximal directional bias increases with increasing return

period. Maximal directional bias for reach catchments will probably be lower than simulated for the conceptual catchment. Simple, linear geometry of the conceptual catchment was designed to maximize the directional bias. Relations between storm duration and intensity versus directional bias for the real catchments will probably be more complex since the geometry of real catchments is more complicated than that of the conceptual catchment. Plots of the relative peak discharge versus relative storm velocity for downstream and upstream storm movement are useful tools for approximative calculation of the directional bias for any combination of storm characteristics. (Baker-IVI)
W85-06640

INVESTIGATION OF THE INFLUENCE OF RAINFALL MOVEMENT ON RUNOFF HYDROGRAPH. PART II - SIMULATION ON REAL CATCHMENTS IN THE CITY OF LUND,
Lund Univ. (Sweden).
J. Niemczynowicz.
Nordic Hydrology, Vol. 15, No. 2, p 71-84, 1984. 10 Fig, 2 Tab, 15 Ref.

Descriptors: *Rainfall, *Hydrographs, *Lund, *Sweden, *Rainfall-runoff relationships Catchments, Runoff, Flow velocity, Rainfall intensity, Rainfall distribution, Storms, Storm runoff.

Previously calculated statistical characteristics of rainfall movement in Lund, Sweden, were used for quantitative description of the influence of storm movement on runoff modeled on real catchments in Lund. The maximal directional bias shown for real catchments is much smaller than for the conceptual catchment, but can still reach a significant value. Maximal directional bias simulated for the Lund catchment is 88% in relation to upstream storm movement, or 31% in relation to stationary storms following intensity-duration-frequency curves. For one catchment in Lund the maximal bias was observed for a rainfall duration of 10 minutes and a return period of 1 year. The maximal directional bias occurs for rainfalls with velocities equal to the average full-flow velocity, weighted for all conduits along the catchment. The average full-flow velocity on Lund catchments is much smaller than the average storm velocity. Rainfalls with velocities equal to this velocity have a small probability of occurrence. For rainfalls with intensites following the intensity-duration-frequency relationships, maximal directional bias will occur at durations approximately equal to 1/5 or 1/3 of the concentration time for the catchment. Long catchments with straight conduits oriented parallel to the on axis of the catchment will show higher directional bias than catchments with a more complicated geometry of sewers. The phenomenon of directional bias can be one of the reasons why the frequency of rainfall does not follow the frequency of runoff. (Baker-IVI)
W85-06641

URBAN RUNOFF PEAK FREQUENCY CURVES,
National Water Research Inst., Burlington (Ontario). Hyrdraulics Research Div.
J. Marsalek.
Nordic Hydrology, Vol. 15, No. 2, p 85-102, 1984. 6 Fig, 4 Tab, 10 Ref.

Descriptors: *Runoff, *Urban runoff, *Rainfall-runoff relationships, Rainfall, Frequency, Flow, Simulation, Catchments, Flow routing, Model studies, Storm sewers.

Runoff peak frequency curves were produced for a fully urbanized catchment from five years of observations and from runoff simulations for storms observed in the catchment and at another station 10.6 km west of the catchment. The simulations were performed by means of the calibrated SWMM III model and, whenever sewer surcharging was encountered, the pressurized flow routing was accomplished by means of the EXTRAN model. The most important parameter for the calibration of runoff peaks was the catchment imperviousness which was calibrated by a regression analysis of observed rainfall and runoff volumes. Observed runoff hydrographs indicated that in the Malvern catchment, which can be characterized by an intermediate imperviousness and well-drained soils, the pervious areas barely contributed to the generation of runoff peaks with return periods up to five years. With a calibrated model, runoff frequency curves can be derived from discrete-event runoff simulations with a better accuracy than that typically achieved for individual events. The SWMM model reproduced the observed runoff peaks fairly well. Results confirm the feasibility of using design storms for establishing design runoff flows provided that the normal antecedent conditions are specified. Such findings may be limited to similar catchments. In catchments with low imperviousness and poorly drained soils, the soil infiltration would play a much more significant role. The EXTRAN model performed satisfactorily in pressurized flow routing. For proper simulation of head losses in the sewer network, head losses at sewer junctions were approximated by increasing the adjacent conduit roughness. The scope of the runoff peak frequency curve decreased in the pressurized flow region. For longer return periods, the sewer system becomes severely surcharged and water overflows out of the system at junction manholes. (Baker-IVI)
W85-06642

EVALUATING A MODEL OF SNOW COVER AREA VERSUS RUNOFF AGAINST A CONCURRENT FLOW CORRELATION MODEL IN THE WESTERN HIMALAYAS,
Howard Univ., Washington, DC.
B. Dey, and D. C. Goswami.
Nordic Hydrology, Vol. 15, No. 2, p 103-110, 1984. 4 Fig, 1 Tab, 11 Ref. NASA grant NAG5-224.

Descriptors: *Snow cover, *Runoff, *Concurrent flow model, *Himalayas, Sutlej River, Indus River, Kabul River, Chenab River, Model studies, Snowmelt, Forecasting.

The results obtained from models of snow-cover area versus runoff are evaluated against the estimates derived from correlation of concurrent flows for the same study period. In all basins under study, correlation of concurrent flows explains the variability in flow better than by the snowcover area-runoff model. In view of the inadequate data base, the strength and weaknesses of the models as revealed by the comparison are to be accepted with caution. As the data base improves in size and diversity, more rigorous and elaborate statistical techniques could be used to compare the efficiency of these models. Unlike the snow cover area model, the concurrent flow correlation model cannot be used for operational forecasting procedures. Its potential lies mainly in simulating flows, filling missing data points and extending flow records for infrequently or inadequately gaged watersheds and in being used as a basis for evaluating and upgrading the snow cover area-runoff models. The usefulness of concurrent flow correlation as an additional input parameter in the snow cover area model for the Indus river has been demonstrated. The snow cover area-runoff models that are being increasingly used in water resources studies and management need to be evaluated in regard to their efficiency and adequacy and the concurrent flow correlation model suggested here provides an alternative. (Baker-IVI)
W85-06643

EFFECT OF LOCAL BOTTOM SLOPE AND ROUGHNESS COEFFICIENT VARIATIONS IN OVERLAND FLOWS,
Ecole Polytechnique Federale de Lausanne (Switzerland).
W. H. Hager.
Nordic Hydrology, Vol. 15, No. 3, p 131-144, 1984. 11 Fig, 7 Ref.

Descriptors: *Roughness coefficient, *Overland flow, *Slope, Kinematic wave theory, Topography, Precipitation, Infiltration, Evaporation, Mathematical equations, Flow.

The effects of local bottom slope and roughness coefficient variations in overland flow over a plane were investigated by using the kinematic wave theory. Results are compared with the usual approach. Certain configurations of surface topography and roughness charcteristics are seen to yield results that deviate from the usual predictions. The local effect of roughness coefficient must be accounted for when surfaces are significantly rougher at the upper than at the lower zones of the catchment area. This study allows a simple application of results since all computations are performed with nondimensional quantities. This particular notation allows a thorough comparison between different configurations of bottom and roughness coefficient variations. (Baker-IVI)
W85-06645

TIME LAG SOLUTION OF THE MUSKINGUM FLOOD ROUTING EQUATION,
M. A. Gill.
Nordic Hydrology, Vol. 15, No. 3, p 145-154, 1984. 3 Fig, 6 Ref.

Descriptors: *Flood routing, *Muskingum Flood Routing Equation, *Time lag, Runoff, Hydrographs, Mathematical equations.

Use of time lag in the Muskingum method of flood routing is explained by considering some specific examples. Time lag method removes undesirable predicted results which are obtained by the conventional method. A method is also proposed for calculating the time lag. The examples which have been considered are of floods which can be described in algebraic terms. The method is, however, of general application and can be adapted to numerical computation. From the examples shown it is clear that the use of $Q(0) = I(0)$ always produces negative or appreciably diminished values of outflow and in some cases outflow values higher in magnitude than the highest value of the inflow during a time interval $0<t<k$. These results are unrealistic from a physical point of view. From a purely mathematical view point use of $Q(0) = I(0)$ as an initial condition may appear to be quite right and unobjectionable but it cannot be accepted from a practical viewpoint. This feature has always been regarded as unrealistic and an essential weakness of the Muskingum method. Since there is not an a priori reason for adhering to this initial condition and, in fact, physical consideration suggests the use of time lag between the inflow and outflow reaches, it has been proposed that a suitable time lag should be incorporated in the initial conditions. Time lag can be calculated by equating the volumes of flood under the inflow and outflow hydrographs. (Baker-IVI)
W85-06646

RUNOFF PATTERN AND PEAK FLOWS FROM MOVING BLOCK RAINS BASED ON A LINEAR TIME-AREA CURVE,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
M. Jensen.
Nordic Hydrology, Vol. 15, No. 3, p 155-168, 1984. 7 Fig, 3 Tab, 5 Ref.

Descriptors: *Rainfall-runoff relationships, *Moving block rain, *Time-area model, *Runoff, Storms, Flood peak, Storm Water Management Model, Mathematical models, Prediction.

The time-area model (TAM) is applied corresponding to a linear time-area curve for a moving block rain and functions for the discharge $Q(X,t)$(X = place, T = time) are derived analytically, for both upstream and downstream storm movement. The relative peak flow (storm peak flow relative to the discharge from the same storm of infinite duration) is found as a function of the dimensionless parameters p1 and p2. The dimensionless parameter p1 is the relative storm velocity times relative storm duration, and p2 is the storm velocity relative to the mean kinematic wave celerity. Dimensionless peak flows are found as functions of p1 and p2 and results are compared with computations from the Storm Water Management Model (SWMM) version 2. TAM overestimated the peak flows by approximately 5% of the full flow capacity relative to SWMM on an average of 26 comparisons. The standard deviation is approxi-

mately 10%. The deviations are small enough to conclude that the dimensionless parameters p1 and p2 dominate the peak flow from moving block rains as predicted by TAM. (Moore-IVI)
W85-06647

WATER USE BY ISOLATED TREES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
J. J. Landsberg, and R. McMurtrie.
Agricultural Water Management, Vol. 8, No. 1-3, p 223-242, January, 1984. 3 Fig, 38 Ref.

Descriptors: *Water use, *Trees, *Transpiration, *Mathematical equations, Leaves, Roots, Energy balance, Soil water, Stomatal conductance, Boundary conditions, Potential gradient.

The paper assesses whether water use by isolated trees can be calculated from weather data, and the consequences of water uptake in terms of soil drying patterns. Since foliage area must be known, published relationships between trunk diameter and foliage mass or area are examined. These are consistent enough to be useful. The volume of tree canopies can be estimated using standard geometrical shapes. Root length per tree must be known, so that root length per unit soil volume (Lv) can be calculated. Root:shoot dry mass ratios vary with age and growing conditions. There are data on Lv but estimates for particular cases are likely to be considerably in error. Methods of estimating the soil volume occupied by roots, and the way roots are distributed, are proposed, so that given an estimate of root mass, Lv and its distribution can be calculated. Transpiration (E) can be calculated from the leaf, energy-balance equations. Work on evaluating net radiation per unit leaf area in isolated trees and hedgerow orchards, and on stomatal and boundary layer conductances, is discussed. Transpiration leads to water loss from leaves, which causes potential gradients through the tree to the roots and hence the soil. Uptake from the soil depends on soil-root potential gradients and Lv. The equations to determine this, given E, are presented for the root system of an isolated tree and then extended to include trees subject to mutual interference. (Author's abstract)
W85-06677

SHALLOW FLOW OF WATER THROUGH NON-SUBMERGED VEGETATION,
Melbourne Univ., Parkville (Australia). Agricultural Engineering Section.
A. K. Turner, and N. Chanmeesri.
Agricultural Water Management, Vol. 8, No. 4, p 375-385, February, 1984. 5 Fig, 4 Tab, 6 Ref.

Descriptors: *Vegetation, *Overland flow, *Mathematical equations, Wheat, Slope, Turbulence, Discharge-depth equation.

The shallow movement of water flowing through dense crops of wheat was studied for different crop densities and sowing patterns and ages. The common application of Manning's equation to such flows is shown to be inadequate, particularly since the flows can be described as mixed rather than turbulent. A more flexible discharge-depth equation is proposed as an alternative. The equation is proposed as a generalized form for which the Manning equation with its fixed exponents for the power terms is a specific expression. The variable exponent for the depth term gave consistent values and indicated that complex nature of the flow sheet. Finally the role of slope on the terms in the discharge-depth equation was included as a separate study. The initial results indicate that for these test conditions, if an exponent of 0.35 is used for the slope term rather than the traditional value of 0.5, a more consistent term results for the resistance effect. Overall, the results indicate further support for this method of describing shallow flows, and it is hoped that additional data will become available for a wider range of crops and pastures. (Baker-IVI)
W85-06684

SIMULATING INFILTRATION INTO FROZEN PRAIRIE SOILS IN STREAMFLOW MODELS,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
For primary bibliographic entry see Field 2G.
W85-06702

MISSISSIPPI SOUND WAVE-HINDCAST STUDY: MAIN TEXT AND APPENDICES A AND B,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. E. Jensen.
Technical Report HL-83-8, Final Report, April 1983. 74 p, 24 Fig, 3 Tab, 35 Ref, 7 Append.

Descriptors: *Hydraulics, *Waves, *Coastal engineering, *Hydraulic structures, Dredging, Navigation, Model studies, Wind, Hindcasting, Tides, Mississippi Sound, Shallow water, SWWM model, Mathematical models, Saginaw Bay.

Long-term overwater winds were generated using data from land-based meteorological stations adjacent to Mississippi Sound. A parametric shallow-water wave model was developed and verified employing extensive measured wave data. The shallow-water wave model and the simulated wind fields were utilized to calculate 20 years (1956-1975) of hindcast wave data for 23 sites in Mississippi Sound. Analyses of the hindcast wave data are presented. Verification of the modeling technique was not possible with the limited wave data available in Mississippi Sound. Results from another study, however, showed that the hindcast data compared favorably with the measured wave data. It is assumed that the shallow-water wave model adequately models finite water depth wave growth and transformation processes and that application to Mississippi Sound is valid.
W85-06912

OBSERVATIONS OF CURRENTS AND WATER PROPERTIES IN COMMENCEMENT BAY,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2L.
W85-06959

STOKES AND RAYLEIGH LAYERS IN PRESENCE OF NATURALLY PERMEABLE BOUNDARIES,
Monash Univ., Clayton (Australia). Dept. of Mathematics.
N. C. Sacheti, and B. S. Bhatt.
Journal of Engineering Mechanics, Vol. 110, No. 5, p 713-722, May, 1984. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Unsteady flow, *Stokes layer, *Raleigh layer, Fluid dynamics, Porous media, Permeability, Mathematical equations, Navier-Stokes equations.

Unsteady flow of viscous incompressible fluid caused by oscillations of a naturally permeable wall bounding the fluid is examined in this theoretical paper. Solutions of the governing Navier-Stokes equations, subject to slip condition at a porous interface, have been obtained by considering oscillatory solutions and an initial value problem. The effect of the permeability of the porous medium enters through a slip grouping parameter, whose influence on the structure of the Stokes' layer has been shown graphically. As a particular case of an initial value problem, the Rayleigh layer was obtained over a naturally permeable wall and compared it with the classical Rayleigh layer for a range of nondimensional paramater. (Author's abstract)
W85-07099

CONVERGENT FLOW PATTERN AT AN ABRUPT CONTRACTION,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
C. Chen, and B. Etemadi.
Journal of Engineering Mechanics, Vol. 110, No. 6, p 894-910, June, 1984. 6 Fig, 1 Tab, 4 Ref, 1 Append.

Descriptors: *Convergent flow, *Contractions, Velocity, Flow patterns, Transformation formula, Open channel flow, Opening ratio, Eccentricity.

The Schwarz-Christoffel transformation formula for flow past an eccentric, normal constriction of zero thickness in a straight channel can be proved to have a simple form of arctangent function from the properties of elliptic integrals. Use of this mapping formula with the aid of another mapping formula between the complex potential and the transformed variable enables one to plot the corresponding flow pattern. Using such transformation formulas, flow graphics for convergent flow are thus developed to plot the flow net and the velocity distributions along the streamlines and across the channel width. To minimize the number of flow patterns in the presentation, the transformation formulas are further normalized by using the channel width and the discharge per unit depth. The normalized flow pattern so plotted is shown to vary only with the two physical parameters, the opening ratio and the eccentricity. Typical convergent flow patterns are plotted to show the validity and applicability of the transformation formulas. (Author's abstract)
W85-07101

2F. Groundwater

IRRIGATION AND GROUNDWATER DEPLETION IN CADDO COUNTY, OKLAHOMA,
North Texas State Univ., Denton. Dept. of Geography.
For primary bibliographic entry see Field 4B.
W85-06234

MODELING PHYSICS AND CHEMISTRY OF CONTAMINANT TRANSPORT IN THREE-DIMENSIONAL UNSATURATED GROUNDWATER FLOW,
Simons, Li and Associates, Inc., Fort Collins, CO.
R. M. Li, Y. H. Chen, J. W. Warner, D. W. Zachmann, and D. V. Pryor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 160653/AS, Price codes: A06 in paper copy, A01 in microfiche. Bureau of Reclamation Project Completion Report, 1984. 114 p, 2 Fig, 5 Tab, Contract/Grant No. 4-CR-93-00010 (1).

Descriptors: *Groundwater movement, *Mathematical models, Colorado, Saturated flow, Unsaturated flow, Path of pollutants.

This report describes the utilization of a vector processor for solving the three-dimensional partial differential equations governing groundwater flow and contaminant transport. The solution utilizes a block implicit scheme to formulate the problem in a highly parallel fashion. Tridiagonal systems arising from this formulation are solved using vectors of length corresponding to the horizontal dimensions of the problem. Solution in parallel fashion then proceeds vertically. Research goals were to develop software to model three-dimensional unsaturated/saturated flow, tailor the algorithm to the vector processor, and determine the economic feasiblity of the approach. The model was successfully developed and tested using a two-dimensional dispersion problem that had analytical solutions, and using a flow and solute recharge problem in three-dimensional groundwater basin considered by Freeze (1971). A series of benchmark tests indicated that the explicitly vectorized form of the model is typically over 500 times faster than the equivalent scalar code on a conventional computer, allowing practical application of the equations of saturated/unsaturated flow for the first time. The ability of the model to analyze the movement of hazardous materials through unsaturated media would allow examination of alternative remedial measures, extent of spill migration and numerous other groundwater problems related to hazardous wastes.
W85-06301

FRACTURE TRACE ANALYSIS TO INCREASE THE PROBABILITY OF LOCATING GROUNDWATER FOR MURRAY COUNTY, GEORGIA,

Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
R. E. Tschirhart, D. W. Kolberg, and N. L. Faust.
Available from the National Technical Information Service, Springfield VA 22161 as PB85 157667/AS, Price codes: A05 in paper copy, A01 in microfiche. Report No. ERC 06-84, September 1984, 54 p, 1 Fig, 24 Ref, Project No. USGS G-836(22).

Descriptors: *Georgia, *Groundwater, *Fracture trace analysis, Lineaments, Geologic fractures, *Hydrogeology, Aerial photography, Remote sensing, Landsat.

Fracture trace analysis was used to determine potential sites to drill for groundwater in the Appalachian Valley and Ridge Province of Murray County, Georgia. Aerial photographs, at a scale of 1:20,000 were analyzed steroscopically to identify the fracture traces. Atlases were made of the seven major 7.5 minute quadrangles in Murray County showing where the fracture traces lie. Developed land and land leveled by flooding in the flood plains tended to obscure fracture traces, whereas undeveloped land, which tended to be in rough terrain, better defined fracture traces. Location of the fracture traces was discussed in terms of the geology of the area. Recharge areas in Murray County were identified using stereoscopic analysis also, but confidence in the reliability of the results was low. Landsat Thematic Mapper data was looked at; however, clouds covered most of the Valley and Ridge Province. The mountainous area, east of the Valley and Ridge Province, showed many lineaments.
W85-06313

HYDRAULIC TECHNIQUE FOR DESIGNING SCAVENGER-PRODUCTION WELL COUPLES TO WITHDRAW FRESHWATER FROM AQUIFERS CONTAINING SALINE WATER,
Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 3B.
W85-06316

GEOLOGICAL FACTORS INFLUENCING WELL PRODUCTIVITY ON THE GEORGIA PIEDMONT,
Georgia Univ., Athens. Dept. of Geography.
G. A. Brook, C.-h. Sun, and T. S. Lloyd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB5 157758/AS, Price codes: A05 in paper copy, A01 in microfiche. Environmental Resources Center Report No. ERC 05-84, Georgia Institute of Technology, Atlanta, September 1984, 92 p, 1 Tab, 1 Fig, 18 Ref, Project No. USGS G-836(04).

Descriptors: Fracture traces, Lineaments, Yield, Specific capacity, *Well productivity, Hydrogeology, Crystalline rocks, Piedmont, *Georgia.

Within the crystalline rocks of the Georgia Piedmont and Mountain districts the probability of obtaining a high productivity well is greater in schists, quartzites, mafic and ultramafic rocks, and graywackes than in granites, gneisses, phyllites, cataclastic, and volcanic rocks. In all rock types well specific capacities and productivities are negatively correlated with well depth, which explains 35% of the variation in the productivities of 250 wells. Analysis of a sample of 30 wells indicates that well depth increases and specific capacity and productivity decreases significantly with increasing distance from a fracture trace intersection mapped from aerial photographs. Some 70% of the variation in well productivity is explained by the model: LN (PROD) = 5.98 - 0.002057 (DISTIN) - 1.5036 (LENDEN) + 0.488 (INTDEN) + 0.000234 (LENTH) where PROD is the well productivity in gpm/ft/1000 ft., DISTIN is the distance in ft. from the well to the nearest fracture trace intersection, LENDEN and INTDEN are the length of fracture traces in mi/sq mi and the number of fracture trace intersections per sq mi, and LENTH is the length of the nearest fracture trace in ft. Results indicate that the best sites for high productivity wells are in areas of heavily fractured bedrock, above fracture trace intersections, and near long fracture traces.
W85-06319

NONTRIBUTARY, NONDESIGNATED GROUND WATER: THE HUSTON DECISION,
For primary bibliographic entry see Field 6E.
W85-06367

INTERPRETATION OF PRESSURE-DEPTH FROM CONFINED UNDERPRESSURED AQUIFERS EXEMPLIFIED BY THE DEEP-BASIN BRINE AQUIFER, PALO DURO BASIN, TEXAS,
Texas Univ. at Austin. Bureau of Economic Geology.
E. D. Orr, and C. W. Kreitler.
Water Resources Research, Vol. 21, No. 4, p 533-544, April, 1985. 10 Fig, 17 Ref. DOE contract DE-AC97-84WM46651.

Descriptors: *Confined aquifers, *Pressure-depth plots, *Deep-Basin Brine aquifer, *Palo Duro Basin, *Texas, Underpressured aquifers, Hydrogeology, Topography, Dip, Potentiometric surface.

Investigations of underpressured aquifers can be improved by accounting for factors that impede accurate interpretation of pressure-depth plots. Poor data quality and distribution obscure true pressure-depth trends. Plotted data may also be distorted by the hydrogeologic setting, i.e., the surface topography, the structural dip of the aquifer, and the potentiometric surface. In the Palo Duro Basin in the Texas Panhandle, distortions caused by the hydrogeologic setting are reduced by delineating regions having little variation in surface topography and in structural dip of the aquifer. Pressure-depth plots for these regions vary considerably. The effects of the hydrogeologic setting on these plots were evaluated by computing pressure-depth data for flow parallel to the structural dip of the aquifer in each region. By comparing regression lines through real pressure-depth data with those through computed data, true hydrologic conditions could be distinguished from the misleading effects of the hydrogeologic setting on pressure-depth plots. (Author's abstract)
W85-06507

ANALYSIS OF THE SPATIAL STRUCTURE OF PROPERTIES OF SELECTED AQUIFERS,
Calvin Coll., Grand MI. Dept. of Engineering.
R. J. Hoeksema, and P. K. Kitanidis.
Water Resources Research, Vol. 21, No. 4, p 563-572, April, 1985. 6 Fig, 6 Tab, 36 Ref. Dept. of the Interior and Iowa Water Resources Inst. Project CT381702, NSF grant CME-8106577.

Descriptors: *Aquifer properties, *Model studies, Spatial distribution, Transmissivity, Permeability coefficient, Water storage.

The spatial structural analysis of properties from several aquifers was investigated in order to quantify for each property the range of typical measures of spatial correlation, structured variability, and unstructured variability along with providing evidence for specific probability density functions. With only a few exceptions, the properties of transmissivity, hydraulic conductivity, and storage coefficient can be considered to be log normally distributed. The range of variation of the three estimated parameters: the variance of small scale fluctuations, the variance of structured fluctuations, and the correlation length, are tabulated. Bedrock aquifers typically display smaller structured transmissivity variability and larger unstructured transmissivity variability than aquifers composed of unconsolidated materials. Possibly due to measurement error and scarcity, no significant spatial correlation was detected in a regional scale between measured values of storage coefficient. (Baker-IVI)
W85-06510

NOTE ON HIGHER-ORDER CORRECTIONS OF THE HEAD COVARIANCES IN STEADY AQUIFER FLOW,
Tel-Aviv Univ. (Israel). Faculty of Engineering.
G. Dagan.
Water Resources Research, Vol. 21, No. 4, p 573-578, April, 1985. 2 Fig, 19 Ref, 2 Append.

Descriptors: *Groundwater movement, *Aquifers, *Head, *Steady flow, Permeability coefficient, Mathematical studies, Covariance.

Average uniform flow takes place in a heterogeneous aquifer of infinite extent. The input to the problem is the hydraulic conductivity, which is regarded as a random space function that is lognormal, stationary and statistically isotropic. The output is the water head field, which is a random function satisfying the equation of steady flow. The first-order approximation of the head, in an asymptotic expansion for small log-conductivity variance, is a normal function characterized completely by the head-log-conductivity cross-covariance and the head covariance or variogram. These covariances are proportional to the log-conductivity variance. By using spectral methods, second-order corrections of the head covariances, proportional to the log-conductivity variance squared, are derived explicitly. Detailed calculations are carried out for an exponential log-conductivity covariance. The main finding of the note is that the first-order approximation is very robust and even for a log-conductivity variance equal to unity, the second-order correction of the head variances is smaller than 10% of the first-order approximation. (Author's abstract)
W85-06511

TRANSPORT OF IMMISCIBLE FLUIDS WITHIN AND BELOW THE UNSATURATED ZONE: A NUMERICAL MODEL,
GeoTrans, Inc., Herndon, VA.
For primary bibliographic entry see Field 5B.
W85-06513

GROUNDWATER CHEMISTRY CHANGE DUE TO TIDAL FLUCTUATIONS IN THE STONEHOUSE BREWERY WELL, PLYMOUTH, ENGLAND,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
I. S. Roxburgh.
Water Resources Research, Vol. 21, No. 4, p 616-618, April, 1985. 8 Fig, 3 Ref.

Descriptors: *Water chemistry, *Groundwater, *Tidal effects, *Saline water intrusion, *Plymouth, *England, Electrical conductivity, Magnesium, Potassium, Sodium, Chloride, Calcium, Nitrates, Hydrogen ion concentration, Wells.

For much of its length, the Plymouth Limestone in England is exposed at the coast and is cut by the Tamar and Plym rivers. The Stonehouse Brewery Well is sunk 24 m into the well-cemented, fissure-dominated Plymouth Limestone. Groundwater within the well is in hydraulic continuity with the marine waters of Plymouth Sound. Groundwater was discharged from the well for 28 hours at approximately 13,500 L/h and samples taken hourly were subsequently analyzed for pH, conductivity, magnesium, potassium, sodium, chloride, calcium, and nitrate. Tidal cyclicity is reflected in the levels of sodium, potassium, chloride, and magnesium observed and to a lesser extent in the levels of calcium. Values for conductivity also altered in sympathy with tidal influences as well as showing an apparent overall rise in average values. The observed values for the pH of samples do not show a readily apparent cyclicity, while nitrate levels clearly show no cyclical pattern. The apparent overall average rise in conductivity and solute concentrations may be linked to the well discharge and its replacement by progressively more saline water from Plymouth Sound. Cyclical changes in the groundwater chemistry are probably linked to the observed rise and fall of tide stage in Plymouth Sound. (Moore-IVI)
W85-06516

INFORMATION FOR STATE GROUNDWATER QUALITY POLICYMAKING,
Oklahoma Univ., Norman. Dept. of Geography.
For primary bibliographic entry see Field 6A.

W85-06535

INTERPRETATION OF LEACHING UNDER MULTIPLE FERTILIZER APPICATIONS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W85-06564

MINERALOGICAL CHANGES ALONG THE FRESHWATER/SALTWATER INTERFACE OF A MODERN AQUIFER,
Florida Univ., Gainesville. Dept. of Geology.
A. F. Randazzo, and J. I. Bloom.
Sedimentary Geology, Vol. 43, No. 1/4, p 291-239, April, 1985. 8 Fig, 42 Ref.

Descriptors: *Aquifer characteristics, *Mineralogy, *Florida, *Saline-freshwater interfaces, Chemical properties, Coastal waters, Dolomite, Wells, Aquifers, Trace elements, Chlorides, Sulfates, Conductivity.

Deposition of carbonate sediments occurred in supratidal, intertidal, and subtidal environments of a carbonate bank along the west coast of peninsular Florida during the Tertiary Period. The position and extent of these environments changed with fluctuations in sea level, and uplift and downwarping of the Florida Platform. During the Miocene, carbonate muds and siliceous clays were deposited in brackish water lagoons. This resulted in the formation of a layer of sediments with low permeability which defines the upper boundary of the Floridan aquifer. During periods of subaerial exposure of the marine sediments, flushing by freshwaters inverted the unstable high-magnesium calcite sediments to low magnesium calcite, accompanied by the inversion of aragonite. Selective dolomitization took place at the freshwater/saltwater interface in the Avonpark, Hawthorn, and upper Tampa Formations. The selectivity of dolomite was related to the fine grain size of the sediments with their high surface area/volume ratio; the occurrence of earlier formed dolomite; the precursor carbonate being aragonite; and the occurrence of clay minerals. Dolomitization proceeded in the freshwater/saltwater mixing zone because mixing freshwater and saltwater can result in a zone where the waters become undersaturated with respect to calcite, yet remain supersaturated with respect to dolomite; the salinity of the mixing zone is lower than it is in seawater, therefore there is less foreign ion competition inhibition dolomite formation; and the magnesium to calcium ion ratio remains well above unity, the level required for dolomitization. Diagenesis of carbonate rocks is a continuous process. Both groundwater and saltwater solutions in contact with the rocks are constantly exchanging ions with the rock to produce the most stable minerals. Carbonate systems tend towards equilibrium with age and time and the expected trend for dolomite is towards a more nearly stoichiometric composition. (Baker-IVI)
W85-06700

USE OF SOLUTE TRACERS RELEASED BY WEATHERING TO ESTIMATE GROUNDWATER INFLOW TO SEEPAGE LAKES,
Maine Univ. at Orono. Dept. of Geological Sciences.
R. E. Stauffer.
Environmental Science and Technology, Vol. 19, No. 5, p 405-411, May, 1985. 1 Fig, 4 Tab, 55 Ref.

Descriptors: *Groundwater movement, *Environmental tracers, *Seepage, *Lakes, *Inflow, *Weathering, Magnesium, Geochemistry, Silicon, Phosphorus, Precipitation.

The steady-state influx to seepage lakes can be estimated by using a solute mass balance, provided the excess of precipitation over evaporation is known for the lake surface. For lakes set in the dolomitic glacial drift of Wisconsin, Mg is an ideal groundwater tracer, both because it has the highest ratio of groundwater concentration to concentration in precipitation and because it behaves nearly conservatively in lakes set in semihumid climates. By use of the Mg mass balance, groundwater inflows were estimated for 10 natural lakes lacking surface inflows and set in pitted glacial outwash in central Wisconsin. The estimated inflows (range = 0.1-2.0 m/year) accord with lakes' different geologic settings and with the lakes' Si and Si/P ratios. The inflow estimates could be improved by better information on the precipitation excess and improved knowledge of the factors regulating Mg concentrations in local vs. regional groundwater flow systems. (Author's abstract)
W85-06705

PLANT COMMUNITIES AND GROUNDWATER LEVELS IN SOUTHERN NASSAU COUNTY, LONG ISLAND, NEW YORK,
City Coll., New York. Dept. of Biology.
J. P. Hanks.
Bulletin of the Torrey Botanical Club, Vol. 112, No. 1, p 79-86, January-March, 1985. 2 Fig, 1 Tab, 22 Ref.

Descriptors: *Vegetation, *Groundwater level, *Nassau County, *Long Island, *New York, *Plant populations, Wetlands, Swamps, Ponds, Streams, Water level, Sewer districts, Succession, Sewer systems.

The vegetation of Nassau County includes 20 different communities; 7 wetland, 3 swamp, 6 upland, 3 stream, and one pond type. The vegetation in the area is largely dependent on the depth to the water table or the depth of surface water. The vegetation in the western section of the study area (Sewage Disposal District 2) has been disturbed by, and responded to, past sewering and other factors and has experienced successional replacement sequences toward drier types of vegetation. Here, the vegetation contains more upland communities and younger communities are more prevalent than in eastern areas (Sewage Disposal District 3). Eastern sections of Nassau County have experienced both more recent and less disturbance and as a result have more extensive aquatic, wetland and swamp vegetation than western areas. (Author's abstract)
W85-06802

COMPARISON OF AQUIFER CHARACTERISTICS DERIVED FROM LOCAL AND REGIONAL AQUIFER TESTS,
Geological Survey, Doraville, GA.
R. B. Randolph, R. E. Krause, and M. L. Maslia.
Ground Water, Vol. 23, No. 3, p 309-316, May-June, 1985. 7 Fig, 3 Tab, 13 Ref.

Descriptors: *Aquifer testing, *Georgia, *Groundwater movement, *Simulation, Model studies, Pumpage, Drawdown, Theis equation, Transmissivity, Anisotropy, Storage.

A comparison of the aquifer parameter values obtained through the analysis of a local and a regional aquifer test involving the same area in southeast Georgia was made in order to evaluate the validity of extrapolating local aquifer-test results for use in large-scale flow simulations. The case study involves an increase in pumpage of 6.3 Mgal/d (million gallons per day) for the local test and a reduction in pumpage of 66 Mgal/d for the regional test, each involving the same well field. The test involved the Floridan aquifer system, a limestone sequence characterized predominantly by secondary permeability in this area. Time-drawdown and time-recovery data were analyzed by using both graphical and least-squares fitting of the data to the Theis curve. Additionally, directional transmissivity, transmissivity tensor, and angle of anisotropy were computed for both tests. The major and minor axes of the transmissivity ellipse determined from the regional test show general agreement with those determined from the local test. A slightly higher ratio of anisotropy was observed on the regional scale: 2.1:1, than on the local scale: 1.5:1. Regional storage coefficients ranged from 0.00034 to 0.00072 as compared with local storage coefficients ranging from 0.00018 to 0.00053. (Author's abstract)
W85-06819

SIMULATION OF GROUND-WATER FLOW IN SOUTHEASTERN OAHU, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
P. R. Eyre.
Ground Water, Vol. 23, No. 3, p 325-330, May-June, 1985. 9 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater movement, *Oahu, *Hawaii, *Aquifers, *Simulation, Model studies, Water table decline, Pumping.

On the leeward side of southeastern Oahu, Hawaii, near-vertical dikes have intruded the gently dipping and highly permeable lava flows of the Koolau mountain. These dikes bound the study area on the north and west and internally divide it into the Waialae and Wailupe-Hawaii Kai aquifers. Recharge to these aquifers, 6 and 9 million gallons per day respectively, has created Ghyben-Herzberg lenses that freely float on sea water and discharge to the sea through coastal sediments. In the Waialae area, where rainfall is high and where thick (poorly permeable) coastal sediments inhibit the discharge of fresh water, heads are 8 to 15 feet above sea level. Lower rainfall and thin coastal sediments that allow easy discharge cause heads to be only 1 to 5 feet in the Wailupe-Hawaii Kai area. The flow of groundwater and the effects of future water development were simulated using AQUIFEM, a two-dimensional finite-element flow model, modified for aquifers containing a sea-water interface. The model provides accurate simulation of observed heads averaged over several years and predicts an additional area-wide head decline of about 1 foot when three recently drilled wells are put into production. (Author's abstract)
W85-06821

EVOLUTION OF REGIONAL HYDROGEOLOGIC SETUP OF A HARD ROCK AQUIFER THROUGH R-C ANALOG MODEL,
National Geophysical Research Inst., Hyderabad (India).
C. P. Gupta, M. Thangarajan, and V. V. S. Gurunadha Rao.
Ground Water, Vol. 23, No. 3, p 331-335, May-June, 1985. 8 Fig, 3 Tab, 4 Ref.

Descriptors: *Aquifers, *India, *Model studies, *Pumping tests, *Andhra Pradesh State, *Hyderabad, *Manaboobnagar, *Geohydrology, Granite, Geologic fractures, Simulation, Porous media, Groundwater level.

Various analytical pumping test methods are, in general, not applicable for estimating hydrogeologic parameters for regional groundwater flow studies in hard rock regions. In such situations, aquifer simulation could be employed as a useful tool to evolve a plausible regional hydrogeological setup provided the groundwater level configuration and its temporal fluctuations are reliably known. An aquifer in granitic terrain was studied in the Hyberadad and Mahaboobnagar districts of Andhra Pradesh State, India. The basin appears to be a closed one with no flow across the boundaries except through a small section of the northern topographic divide. During model calibration, the field estimates of hydrogeological parameters as well as those of recharge and ground-water extraction were appropriately modified. A first-order estimate of the effluent outflow from the aquifer to ephemeral streams was made only from the flow model. The calibrated model satisfactorily reproduced the historical response of the aquifer and could be used for prognosis. Using the available sparse geohydrological data in a hard rock aquifer, one could proceed in a logical manner to gradually modify the field estimates and arrive at a consistent set of these parameters. An essential prerequisite is that the concept of equivalent porous media on a regional scale should be valid and correct water level data and their spatio-temporal variation should be known. Such an approach can additionally provide useful clues in designing a data collection network at minimal cost. (Collier-IVI)
W85-06822

AUTOMATIC GENERATION OF FLOW NETS WITH CONVENTIONAL GROUND-WATER MODELING ALGORITHMS,
Texas Univ. at Austin. Bureau of Economic Geol-

ogy.
G. E. Fogg, and R. K. Senger.
Ground Water, Vol. 23, No. 3, p 336-344, May-June, 1985. 9 Fig, 2 Tab, 15 Ref. U.S. Department of Energy, Office of Nuclear Waste Isolation contract DE-AC-97-83WM46615.

Descriptors: *Flow nets, *Groundwater movement, *Model studies, *Algorithms, *Palo Duro Basin, *Texas, *New Mexico, Permeability coefficient, Boundary conditions, Hydraulic head, Geohydrology.

Though flow nets offer one of the best means of visualizing ground-water flow fields, accurate construction of flow nets can be very difficult in heterogeneous, anisotropic media or in regional cross sections where vertical exaggeration of scale is great. A method was developed for automatically generating the streamlines of a flow net using conventional ground-water flow modeling algorithms. The method can be implemented using most any of the existing computer programs for flow modeling, and no modification of the programs is necessary. One need only replace the hydraulic head and conductivity terms in the steady-state ground-water flow equation with the stream function and an inverse form of hydraulic conductivity, respectively. Possible boundary conditions include prescribed stream function (Dirichler type) and prescribed stream function gradient (Neumann type). The former can be determined from prior knowledge of recharge or discharge rates or from boundary fluxes computed in previous simulations of hydraulic head distribution. The latter can be determined from data on hydraulic head along the boundaries, raising the possibility of solving for the streamlines directly without first solving for the head distribution. The method is generally not appropriate when sources or sinks occur inside the flow region, and it will not handle transient conditions. Accuracy of the method was demonstrated in three hypothetical test problems and a vertical-plane model through the Palo Duro Basin of Texas and New Mexico. (Author's abstract)
W85-06823

REJECTION OF RECHARGE WATER FROM MADISON AQUIFER ALONG EASTERN PERIMETER OF BIGHORN ARTESIAN BASIN, WYOMING,
Wyoming Univ., Laramie. Dept. of Geology and Geophysics.
P. W. Huntoon.
Ground Water, Vol. 23, No. 3, p 345-353, May-June, 1985. 6 Fig, 3 Tab, 22 Ref.

Descriptors: *Wyoming, *Bighorn, *Artesian basins, *Aquifers, *Recharge, *Paleozoic aquifers, Permeability, Artesian springs, Transmissivity, Karst hydrology.

Approximately half of the perimeters of Wyoming foreland artesian basins are characterized by structural continuity of the Paleozoic aquifers between the recharge areas and the interior parts of the artesian basins. A significant percentage of the ground water which circulates through such recharge areas is rejected through springs because there is a marked decrease in transmissivity basinward from the recharge areas. The transmissivity contrasts have developed since the recharge areas became morphologically differentiated from the basin interiors during post-Laramide time. Secondary enhancement of permeabilities is occurring in the recharge areas through dissolution of the rock matrix and cement, and in some locations the rocks were tectonically fractured. In contrast, the rate of dissolution within the basin interiors are substantially decreased, or processes of recrystallization, cementation, or compaction are operating to destroy permeability. The result is that in the case treated here, net recharge to the basin interior is a small fraction of measured stream losses in the headwaters of the recharge area. (Author's abstract)
W85-06824

DISTRIBUTION OF VOLATILE ORGANIC COMPOUNDS IN A NEW JERSEY COASTAL PLAIN AQUIFER SYSTEM,
Geological Survey, Trenton, NJ.
For primary bibliographic entry see Field 5B.
W85-06825

INTERFERENCE DUE TO NEIGHBORING WELLS DURING PUMPING TESTS,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton.
Ground Water, Vol. 23, No. 3, p 361-366, May-June, 1985. 4 Fig, 5 Tab, 3 Ref.

Descriptors: *Groundwater potential, *Pumping tests, *Wells, *Aquifers, Drawdown, Theis equation, Algorithms, Transmissivity, Storage.

Pumping test analysis is usually based on the assumption that the aquifer is in a state of equilibrium before the test starts. Corrections can be made for seasonal changes, but the effects of other pumping wells are often ignored because the wells are considered to be too distant to have a significant influence. Even if an interfering well is relatively close, it is usually assumed that its effect can be ignored provided that its pumping rate is maintained at a steady value during the period under consideration. If the interfering wells are several kilometers away, they can still have a significant effect on test results. The interference is usually apparent as a deviation from the conventional aquifer response and may be misinterpreted as a boundary effect. By combining the series expansions for the Theis expression for the pumped and interfering wells, the magnitude of the interference depends primarily on the length of time for which the interfering well pumps before the start of the test. The distance between the test and interfering wells has a small effect. An equation was developed which allows an estimate to be made of magnitude of the interference effect; this equation also can be used to correct the observed drawdowns. (Collier-IVI)
W85-06826

LUMPED PARAMETER MODEL: FURTHER APPLICATION IN CHALK AQUIFERS, U.K.,
Binnie and Partners, London (England).
D. M. Walsh, and S. Puri.
Ground Water, Vol. 23, No. 3, p 377-380, May-June, 1985. 6 Fig, 1 Tab, 4 Ref.

Descriptors: *Lumped parameter models, *Chalk Aquifer, *England, *Aquifers, *Model studies, Transmissivity, Stream discharge, Pumping, Groundwater level, Water level, Water table.

A lumped parameter groundwater model was developed which permitted inexpensive and rapid investigations if the principal constraints to be considered when investigating a proposed river augmentation scheme in a relatively complicated Chalk catchment in southern England. A previously published lumped parameter model explained an unusual chalk aquifer consisting of a thin zone of high storage and transmissivity whose response of small annual fluctuations and high stream flows were considered to be anomalous. A similar model has been further developed and used in a preliminary desk study of possible river augmentation schemes. The model developments incorporate stream bed leakage to the aquifer and saturated depth varying transmissivity. When water levels are very high, and maximum fissure density is fully saturated, the transmissivities can reach very high values but the drop-off of transmissivity with water level decline is fairly rapid. Two hydraulic conductivity values separated by a thin transition zone mathematically represent the aquifer. Although it is necessary to invoke a transition zoned because of numerical instability, such a zone is now thought to be present in most chalk aquifers of the United Kingdom. The model is versatile in its ability to test a variety of control rules for groundwater abstraction. The newly incorporated factors are significant for assessment of the degree of success of augmentation proposals. This lumped model gave valuable guidance for future field investigations. (Collier-IVI)
W85-06827

POWER OF THE ELECTRONIC WORKSHEET: MODELING WITHOUT SPECIAL PROGRAMS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
T. N. Olsthoorn.
Ground Water, Vol. 23, No. 3, p 381-390, May-June, 1985. 11 Fig, 2 Ref.

Descriptors: *Computer models, *Spreadsheets, *Software, *Microcomputers, *Groundwater movement, Model studies, Finite difference methods, Data processing.

So-called spreadsheet programs are forerunners of new general software from which the groundwater engineer is likely to benefit - no more special programs each capable of fulfilling just the single task it was explicitly designed for, but programs suitable to do almost any job, where only the imagination of the user limits the possibilities. Moreover, this new software is very user friendly, proving that it is unneccessary to be a computer specialist to use it. With a spreadsheet you can build a simple finite-difference model from scratch within one or two minutes. With some extra time a wide variety of problems can be solved as the multiaquifer, three-dimensional, phreatic and transient groundwater flow examples prove. Using this software, any hydrologist should be able to solve diverging groundwater models without depending on special numerical models. A good knowledge of the water balance is all that is needed beyond a microcomputer and a spreadsheet program. (Author's abstract)
W85-06828

COMPARISON OF SAMPLING MECHANISMS AVAILABLE FOR SMALL-DIAMETER GROUND WATER MONITORING WELLS,
IEP, Inc., Worthington, OH.
D. M. Nielsen, and G. L. Yeates.
Ground Water Monitoring Review, Vol. 5, No. 2, p 83-99, Spring, 1985. 8 Fig, 13 Tab, 18 Ref.

Descripors: *Monitoring, *Groundwater, *Wells, *Sampling, Water quality control, Aquifers, Physical properties.

Several well-designed devices are available for retrieving ground water samples from small diameter monitoring wells. Obtaining the most representative samples with one of these devices is largely dependent on choosing the appropriate sampling device for a particular sampling situation. The selection of a sampling device for a monitoring well or series of wells must include the consideration of a number of details. These considerations are tabulated for each of the types of sampling devices described. Based on these and other considerations, each of these devices has characteristics that makes it suitable for sampling under specific sets of conditions. No one method is applicable to all situations, however, for nearly all situations there is at least one appropriate sampling device available. Sampling equipment available today ranges from simple to highly sophisticated, and includes bailers, syringe devices, suction-lift pumps, gas-drive devices, bladder (Middelburg-type) pumps, gear-drive and helical rotor electric submersible pumps and gas driven piston pumps. (Baker-IVI)
W85-06834

CHEMICAL EQUILIBRIUM MODEL FOR THE ILLINOIS BASIN FORMATION WATERS,
University of Western Ontario, London. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W85-06872

DATA FOR SELECTED WELLS IN NORTHERN WISCONSIN DROUGHT AND GROUND LEVELS IN NORTHERN WISCONSIN: APPENDIX B,
Wisconsin Geological and Natural History Survey, Madison.
A. Zaporozec.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-130997,

Report No. NSF/RA-800659, 1980. National Science Foundation, Washington, DC. 135 p, 30 Fig, 52 Ref. Contract/Grant No. OSS7723964.

Descriptors: *Groundwater levels, *Groundwater, *Wells, Precipitation, Geohydrology, *Wisconsin, Shallow wells, Hydrographs, Water level, Water table, Drought.

Precipitation records and long-term, ground-level measurements are presented for shallow wells in a glaciated area of northern Wisconsin. The wells are arranged alphabetically by county. A complete data set for each well contains a location map and tables showing the following: summary of groundwater levels; average monthly groundwater levels; hydrographs of monthly high water levels; relation of annual groundwater levels to precipitation; longest duration of extreme groundwater levels; probability of exceedance of groundwater levels; frequency of weekly groundwater levels; exceedance of weekly groundwater levels; total precipitation at nearest station; and monthly mean discharge. (Author)
W85-06894

HELIUM ACCUMULATION IN GROUNDWATER, I: AN EVALUATION OF SOURCES AND THE CONTINENTAL FLUX OF CRUSTAL 4HE IN THE GREAT ARTESIAN BASIN, AUSTRALIA,
Australian National Univ., Canberra. Research School of Earth Sciences.
T. Torgersen, and W. B. Clarke.
Geochimica et Cosmochimica Acta, Vol. 49, No. 5, p 1211-1218, May, 1985. 2 Fig, 2 Tab, 44 Ref.

Descriptors: *Great Artesian Basin, *Australia, *Helium isotopes, *Groundwater, Geochemistry, Water chemistry, Weathering, Uranium, Thorium, Chemical analysis, Confined aquifers.

The rate of accumulation of He-4 in the groundwaters of the J-aquifer of the Great Artesian Basin, Australia has been determined using C-14 and hydrologic ages. The rate of accumulation of He-4 in the Basin is the result of two processes. In young water (aged <50,000 years) the rate of accumulation of He-4 can be accounted for by the in situ production of He-4 by the alpha-decay of U and Th series elements with the release factor for helium near 100%. In the main part of the basin (>100,000 years), the rate of accumulation of He-4 is about 74 times the rate of in situ production and cannot be accounted for by in situ weathering and the subsequent release of He-4 trapped in mineral grains over geologic time. The rate of accumulation of He-4 in the older waters of the Basin can be accounted for by the flux of He-4 from the whole crust. The Auob Sandstone of Namibia would also appear to reflect such a whole crust He-4 flux and the data of numerous other authors strongly suggest large He-4 sources outside the confines of individual groundwater bodies. The observation of a whole crust He-4 flux and crustal degassing of He-4 probably requires the release of He-4 by rock fracturing and may require facilitated transport of He-4 through the crust. (Baker-IVI)
W85-07035

NONLINEAR RESPONSE OF COUPLED FLOW-STRESS PROBLEMS,
San Diego State Univ., CA.
For primary bibliographic entry see Field 8D.
W85-07103

2G. Water In Soils

SOIL STRUCTURE EFFECTS AND LEACHING OF SODIUM FOLLOWING SODIUM CHLORIDE FERTILISER APPLICATIONS,
Lincoln Coll. (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 2K.
W85-06184

REGIONAL-SCALE ESTIMATES OF SURFACE MOISTURE AVAILABILITY FROM GOES INFRARED SATELLITE MEASUREMENTS,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 7B.
W85-06188

SOME SENSITIVITY RESULTS FOR CORN CANOPY TEMPERATURE AND ITS SPATIAL VARIATION INDUCED BY SOIL HYDRAULIC HETEROGENEITY,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2I.
W85-06193

CONSTANT HEAD WELL PERMEAMETER: EFFECT OF UNSATURATED FLOW,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
W. D. Reynolds, D. E. Elrick, and B. E. Clothier.
Soil Science, Vol. 139, No. 2, p 172-180, 17 Ref.

Descriptors: *Unsaturated flow, *Constant head well permeameter, Permeability coefficient, Flow rates, Soil water, Water tables.

The constant head well permeameter (CHWP) theory is extended analytically to account for the effects of unsaturated flow. This results in a more accurate estimate of the field-saturated hydraulic conductivity and in new methods for in situ estimation of the soil sorptivity and the alpha parameter of the exponential hydraulic conductivity-presssure head function. The original CHWP theory is found to be a special case of the extended theory where there is no capillarity. The extended theory successfully predicts many of the conclusions drawn from previous numerical investigations of the CHWP method. In so doing it also established the approximate functional relationships between the major factors influencing the method. (Baker-IVI)
W85-06208

LEACHING FROM A TROPICAL ANDEPT DURING BIG STORMS: A COMPARISON OF THREE METHODS,
Florida Univ., Gainesville. Dept. of Botany.
A. E. Russell, and J. J. Ewel.
Soil Science, Vol. 139, No. 2, p 181-189, February, 1985. 2 Fig, 2 Tab, 41 Ref.

Descriptors: *Leaching, *Storm seepage, *Soil water, Lysimeters, Darcy flow equation, Water balance, Nutrients, Flow, Saturated flow.

Water and nutrient leaching in the field was measured using three methods: estimates of flux using the Darcy flow equation, a water balance, and zero-tension lysimeters. The measurements were taken in an Andept near Turrialba, Costa Rica, during two large storms 33 and 22 cm/wk at two soil depths 25 and 110 cm. Mean water flows calculated by the flux and water balance methods were significantly different. The flux method overestimated water flow during the 22 cm storm. Mean water flow determined from zero-tension lysimeter data during both storms was substantially lower than that estimated by the other two methods. Nutrient leaching was determined two ways. First, nutrient concentrations measured using porous cup samplers were multiplied by water flows derived from water balance data. Second, nutrient concentrations of leachate collected by zero-tension lysimeters were multiplied by water flows from the lysimeters. In general, nutrient losses determined by the first method were greater than those measured by zero-tension lysimeters. In soil where lateral flow is relatively unimportant and impeding layers do not occur, the lysimeters provide a measure of the occurrence and quality of rapid channelized flow. (Baker-IVI)
W85-06209

EFFECT OF VEGETATION ON SOIL MOISTURE SENSING OBSERVED FROM ORBITING MICROWAVE RADIOMETERS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
J. R. Wang.
Remote Sensing of Environment, Vol. 17, No. 2, p 141-151, April, 1985. 6 Fig, 30 Ref.

Descriptors: *Vegetation effects, *Soil water, *Satellite technology, *Microwave radiometry, Remote sensing, Measuring instruments, Radiometry, Soil properties.

Remote sensing of soil moisture by microwave radiometers at satellite altitudes has been examined. The effect of vegetation cover observed by ground level radiometric measurements was also present in large area observations by the Skylab 1.4 GHz radiometer and the 6.6 and 10.7 GHz channels of Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR). The high altitude observations of vegetation effect showed strong frequency dependence. The effect of vegetation introduces ambiguity in moisture sensing by a microwave radiometer. An independent means of estimating biomass of vegetation cover is needed to determine soil moisture uniquely by remote microwave radiometric measurements. The polarization factor defined from the SMMR dual-polarized radiometric measurements at 6.6 and 107 GHz frequencies is sensitive to soil moisture variation when vegetation cover is not dense. Correlation of this factor with horizontally polarized brightness temperature could be useful in isolating the effects of vegetation cover and surface roughness from soil moisture variation. (Baker-IVI)
W85-06215

RELATIONS BETWEEN AVAILABLE AND EXTRACTABLE SOIL WATER AND EVAPOTRANSPIRATION FROM A BEAN CROP,
Lincoln Coll. (New Zealand). Dept. of Soil Science.
J. B. Reid, O. Hashim, and J. N. Gallagher.
Agricultural Water Management, Vol. 9, No 3, p 193-209, November, 1984. 7 Fig, 4 Tab, 34 Ref.

Descriptors: *Evapotranspiration, *Soil water, *Estimating, Model studies, Crop yield, Irrigation, Available water, Extractable water.

The accuracy of available and extractable soil water estimates was investigated using irrigated and unirrigated beans grown in an alluvial silt loam in Canterbury, New Zealand. Available water capacity was defined as the difference between soil water contents in the root zone at the drained upper limit (DUL) and at the lower limit (LL) as estimated by laboratory procedures. Extractable water capacity was specified as the difference between field estimates of DUL and LL for the whole profile affected by roots. DUL was estimated in the laboratory by equilibrating soil cores at matric potentials at -10, -20, or -30 kPa, and in the field by neutron moderation. In the field LL was measured by neutron moderation on plots where evaporation had apparently ceased due to drought stress. Estimates of the DUL, LL and available water capacity may be useful for irrigation management, are misleading indicators of the distribution of water available for uptake by crops. Lab estimates of these variables seem especially prone to inaccuracy in the latter respect, and field estimates are preferable. Even estimates of extractable water can be inaccurate because of upward fluxes of water into the root zone. Apparent and effective rooting depths need not necessarily be the same. In some situations the time required for a thoroughly wetted soil to drain to the DUL can lead to significant inaccuracies in water balance calculations. These inaccuracies can largely be avoided by the use of a simple equation which relates drainage rate to soil water content in excess of the DUL. It is important that irrigation/water use experiments on alluvial soils should make appropriate observations of soil variability. Insufficient attention to this aspect may result in errors when results from experimental plots are used to predict soil water behavior over larger areas. (Baker-IVI)
W85-06279

CALIBRATION OF NEUTRON MOISTURE METERS ON STONY SOILS (NOTE),
Ministry of Agriculture and Fisheries, Ashburton (New Zealand). Winchmore Irrigation Research Station.
For primary bibliographic entry see Field 7B.

W85-06435

STOCHASTIC ANALYSIS OF UNSATURATED FLOW IN HETEROGENEOUS SOILS; 1. STATISTICALLY ISOTROPIC MEDIA,
New Mexico Inst. of Mining and Technology, Socorro.
T.-C. J. Yeh, L. W. Gelhar, and A. L. Gutjahr.
Water Resources Research, Vol. 21, No. 4, p 447-456, April, 1985. 8 Fig, 30 Ref. NSF grants ENG 75-14184 and CEE-8311786, EPA grant R-806092.

Descriptors: *Unsaturated flow, *Steady flow, *Stochastic hydrology, Model studies, Soil water, Soil properties, Permeability coefficient, Infiltration, Porosity, Porous media.

Steady unsaturated flow with vertical mean infiltration through unbounded heterogeneous porous media is analyzed using a perturbation approximation of the stochastic flow equation which is solved by spectral representation techniques. The general formulation of the problem is emphasized along with solution techniques. Specific results are developed for the case of vertical mean infiltration when alpha is a deterministic constant, with a three-dimensional statistically isotropic and a one-dimensional representation of the hydraulic conductivity variation. The mean behavior of the flow is determined in terms of an effective hydraulic conductivity relationship expressed as a function of mean capillary pressure. Conditions under which the flow becomes one-dimensional are established from comparisons of the variance of capillary pressure head. (Baker-IVI)
W85-06499

STOCHASTIC ANALYSIS OF UNSATURATED FLOW IN HETEROGENEOUS SOILS; 2. STATISTICALLY ANISOTROPIC MEDIA WITH VARIABLE ALPHA,
New Mexico Inst. of Mining and Technology, Socorro.
T.-C. J. Yeh, L. W. Gelhar, and A. L. Gutjahr.
Water Resources Research, Vol. 21, No. 4, p 457-464, April, 1985. 5 Fig, 1 Tab, 13 Ref, 1 Append.

Descriptors: *Unsaturated fow, *Steady flow, *Stochastic hydrology, Model studies, Soil water, Soil properties, Permeability coefficient, Infiltration, Porosity, Anisotropy.

Natural soils or geological formations, in general, exhibit bedding or stratification. Because of this geological structure, hydrologic properties of the porous media should be considered to be statistically anisotropic. Steady unsaturated flow in heterogeneous soil with an arbitrarily oriented mean hydraulic gradient is analyzed using spectral solutions of the stochastic perturbation equation which describes the capillary pressure head. Several general cases with variable alpha and statistical anisotropy are developed. These analyses explore the anisotropy of effective hydraulic conductivity for unsaturated flow and the effect of the variability of alpha on the variance of capillary pressure head. The effective hydraulic conductivity for arbitrary orientation of the mean hydraulic gradient is shown to have tensorial properties, but its components depend on the magnitude and direction of the hydraulic gradient and the orientation of the stratification in the soil. When alpha is random, the degree of anisotropy of the effective conductivity depends strongly on mean capillary pressure. The variance of the capillary pressure head increases with increasing mean capillary pressure. The anisotropy of effective unsaturated hydraulic is strongly dependent on the mean capillary pressure. (Baker-IVI)
W85-06500

STOCHASTIC ANALYSIS OF UNSATURATED FLOW IN HETEROGENEOUS SOILS; 3. OBSERVATIONS AND APPLICATIONS,
New Mexico Inst. of Mining and Technology, Socorro.
T.-C. J. Yeh, L. W. Gelhar, and A. L. Gutjahr.
Water Resources Research, Vol. 21, No. 4, p 465-471, April, 1985. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Stochastic process, *Unsaturated flow, *Soil water, Capillary flow, Anisotropy, Permeability coefficient, Groundwater recharge, Path of pollutants, Runoff, Vadose zone.

The results of the stochastic theory developed for flow in heterogeneous soils predict the general behavior of the variability of capillary pressure or moisture content in a field situation. The variability of capillary pressure or moisture content increases when mean capillary pressure increases. The anisotropy ratio (horizontal/vertical) of effective (mean) unsaturated hydraulic conductivity increases when mean capillary pressure increases or mean moisture content decreases. The importance of the correlation scale in effective hydraulic conductivity is demonstrated through a direct comparison of the anisotropy ratios derived from both the stochastic result and a direct average method. Through examples of recharge, pollutant migration, and rainfall-runoff problems in large-scale vadose zones, the importance of the new unsaturated hydraulic conductivity anisotropy concept in hydrologic applications is stressed. The theoretical results are applied to study practical problems associated with liquid waste isolation, pollutant migration, and design of capillary barriers for shallow underground waste storage. Applications of the theoretical results to field situations require information on the statistical properties of the processes. (Baker-IVI)
W85-06501

TWO-PHASE NUMERICAL MODEL FOR PREDICTION OF INFILTRATION: APPLICATIONS TO A SEMI-INFINITE SOIL COLUMN,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, and J. A. Billica.
Water Resources Research, Vol. 21, No. 4, p 607-615, April, 1985. 12 Fig, 11 Ref. NSF grant CEE-8212668.

Descriptors: *Mathematical models, *Infiltration, *Soil water, Algorithms, Simulation, Computers, Costs, Boundary conditions, Two-phase models, Air phase, Water content profile.

A numerical algorithm for prediction of infiltration and water content profiles evolution in a soil column is derived from the two-phase flow theory for water and air. The approach provides a more physical description of the process of infiltration and of water content profiles evolution in a soil column. When water contents are high, that is as ponding is approached and after ponding has occurred, the two-phase approach not only may provide the proper answer but does so at lower cost than by the one-phase approach. The governing equations reduce to the usual one-phase flow equations by setting a parameter to a zero value. The model can shift back and forth from the one-phase to the two-phase mode within the course of a simulation as demanded by the situation. The need for the two-phase approach is demonstrated for several situations with a semi-infinite lower boundary condition, when the two-phase approach might appear a priori least needed. It is needed even for a semi-infinite soil column when mobile air cannot be confined. Naturally, for other lower boundary conditions such as an impervious bottom at a finite depth or the presence of a fluctuating water table, the two-phase approach, including air compression efects, becomes the only feasible one on multiple counts of realism, accuracy, stability, and cost. The two-phase computer runs actually cost less than the corresponding one-phase runs. The two-phase algorithm is naturally more stable than the one-phase algorithm when the water contents are high in a portion of the column. Thus the two-phase approach is not only more realistic, but it is even less expensive whenever it is needed. (Moore-IVI)
W85-06515

FLUX AND WATER CONTENT RELATION AT THE SOIL SURFACE,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J.-Y. Parlange, W. L. Hogarth, J. F. Boulier, J. Touma, and R. Haverkamp.
Soil Science Society of American Journal, Vol. 49, No. 2, p 285-288, March-April, 1985. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Soil water movement, *Soil physics, *Soil surface, *Erosion, *Infiltration, Ponding, Runoff, Sand, Erosion control, Mathematical equations, Soil properties.

The prediction of the increase of the water content at a soil surface for a surface flux measured as a function of time, represents an important problem of soil physics. Of particular importance is the determination of the time when incipient ponding first occurs, which determines the onset of surface runoff and possible surface erosion. A general analytical equation is presented which relates the surface water content and surface flux. There is no limit given to any particular soil behavior, and the time dependence of the surface flux is arbitrary. While the equation is approximate, it is optimal at least in the short time limit. Comparisons with numerical and experimental results from Grenoble sand and when the surface flux is constant are used to assess the accuracy of the equation. If the analytical results were used to predict the time at which a certain water content is to be reached at the surface, the difference in the analytical and numerical results, though small, would be significant. The numerical solution has an intrinsic error in the short time limit, suggesting that the analytical result may be more accurate than the numerical solution. The good agreement between the numerical results and an earlier approximate analytical solution reinforces this suggestion. (Baker-IVI)
W85-06538

TIME DOMAIN REFLECTOMETRY FIELD MEASUREMENTS OF SOIL WATER CONTENT AND ELECTRICAL CONDUCTIVITY,
Agricultural Research Service, Riverside, CA. Salinity Lab.
S. Dasberg, and F. N. Dalton.
Soil Science Society of American Journal, Vol. 49, No. 2, p 293-297, March/April, 1985. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Soil water, *Electrical conductivity, *Saline soils, *Time domain reflectometry, Gravimetry, Neutron scattering, Soil properties.

The conventional method for measuring soil salinity is by taking soil samples and determining the electrical conductivity of the extract of a saturated soil paste. These measurements can be converted into soil solution salt concentration by correcting for the soil water content at the time of sampling. Simultaneous measurements of volumetric water content and bulk electrical conductivity were made using time domain reflectometry (TDR) with a single parallel transmission line (PTL) imbedded in the soil. Sixty PTL's were installed at five depths in 12 existing lysimeter plots, irrigated with different amounts of water at two salt concentrations (1.3 and 3.1 dS/m). The correlation between TDR and gravimetric determination is similar to that between neutron and gravimetric determination, but it is somewhat closer to a 1:1 relationship. Another test of the validity of the TDR determined water content measurements was carried out during irrigation of the experimental plots. The water balance for all plots was calculated using TDR, neutron measurements and applied water. The discrepancy between the water actually applied and that measured by TDR and neutron probe seem to reflect soil variability. In many cases the differences between the two neutron sites per plot are as great or greater than the differences between TDR and neutron measurements. Both measurements seem to give a true estimate of water content for their sampling volume, and no conclusion can be drawn which method gives a better estimate of water content. More rigorous testing is needed to reach such a conclusion. (Baker-IVI)
W85-06539

LEACHING AND WATER REQUIREMENT STUDIES IN A GYPSIFEROUS DESERT SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
For primary bibliographic entry see Field 3F.
W85-06540

STATE MODEL FOR INFILTRATION,
Helsinki Univ. of Technology, Espoo (Finland). Systems Theory Lab.
K. Pingoud, and P. J. Orava.
Nordic Hydrology, Vol. 15, No. 3, p 113-130, 1984. 5 Fig, 7 Ref.

Descriptors: *Infiltration, *Model studies, *Soil water, Philips equation, Runoff, Mathematical equations, Unsaturated flow, Ponding, Rainfall-runoff models, Ponding, Rainfall-runoff relationships.

A state model for infiltration is presented which is based on a spatial discretization of partial differential equations of vertical water-movement in unsaturated homogeneous soil. A transformation of the spatial coordinate is made in the basic equations, thus allowing the representation of a semi-infinite soil in the state form. The aim of the model is to describe the dynamical relationship between ponding conditions in the catchment and infiltration during highly variable rainfall rates so that the model can be used flexibly as part of larger rainfall-runoff models. The model is intended to be combined with short-term surface runoff models applied to storm water modelling. The infiltration process is assumed to take place in semi-infinite unsaturated soil. This idealization can be motivated if the water table is rather far from the surface and the model is intended to describe only the infiltration rate at the surface. In classical infiltration equations such as Philip's equation the soil is also assumed to be semi-infinite so that a direct comparison of the model with these equations is possible. The combination of the infiltration model with a surface runoff model containing several state variables seemed to give satisfactory results assuming that the rainfall and initial saturation of the soil are horizontally relatively uniformly distibuted along the catchment. In spite of the relative simplicity of the method for estimating infiltration in surface runoff models, it is far more realistic than the use of explicit infiltration equations such as Philip's equation, because the varying ponding conditions in the catchment are considered in the model. (Baker-IVI)
W85-06644

EVAPOTRANSPIRATION AND SOIL HETEROGENEITY,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2D.
W85-06679

WATER BALANCE UNDER WHEAT MODELLED WITH LIMITED SOIL DATA,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils.
E. S. Greacen, and C. L. Hignett.
Agricultural Water Management, Vol. 8, No. 1-3, p 291-304, January, 1984. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Water balance, *Wheat, *Soil water, *Mathematical models, *New South Wales, Permeability coefficient, Roots, Evapotranspiration, Clay, Soil water capacity, Hydrologic properties.

The dominant role of water in determining yield, and the possibility of describing water storage and movement in the soil with reasonable accuracy have led to the hope of establishing patterns of hydrologic behavior of relevance to agronomy for the major wheatland soils of Australia. CEREAL is a single layer water balance model which utilizes the moisture characteristic and the hydraulic conductivity function of the soil. The model was run on wheat crops at 23 sites in the winter rainfall region of south-east Australia. For red soils in New South Wales the best result was a root mean square deviation (RMSD) of 11 mm (between predicted and measured stored water) for 18 sites using a deep drainage option with field-determined available water capacity (AWC); a laboratory measurement of AWC gave an RMSD of 15 mm. The model CEREAL assumes a general relationshop between root length and evapotranspiration, and error due to this assumption is included in RMSD. The model performed poorly on cracking clays, giving a RMSD of 35 mm; this improved to 25 mm when the simulated rate of root growth was reduced by 30%. The model overall performed reasonably for red soils with the set root function, but there were some aberrations that have not been explained. The possibility exists of predicting the hydrological properties of wheatland soils from texture and field structure. (Moore-IVI)
W85-06680

IN SITU WATER TRANSMISSION CHARACTERISTICS OF A TROPICAL SOIL UNDER RICE-BASED CROPPING SYSTEMS,
Central Soil Salinity Research Inst., Karnal (India). Div. of Soils and Agronomy.
S. S. Hundal, and S. K. De Datta.
Agricultural Water Management, Vol. 8, No. 4, p 387-396, February, 1984. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Rice, *Soil water, *Water transmission, Permeability coefficient, Percolation, Hydraulic conductivity, Soil saturation, Soil matric potential, Diffusivity.

In soils under rice-based cropping systems in Asia water movement and distribution in the root zone of rice and dryland crops are important for efficient water management. Saturated hydraulic conductivities in the wetland soil profile were evaluated from measurements of hydraulic gradients and percolation rates in the field. The subsoil layer (15-60 cm) restricted percolation rate to a greater degree than the puddled top soil. Unsaturated hydraulic conductivities and soil water diffusivities in the soil profile under dryland conditions were obtained from simultaneous measurements of soil water content using the neutron moderation technique and the soil matric potential by tensiometers over time and soil depth. Soil matric potential versus hydraulic conductivity and soil water content versus soil water diffusivity relations of various soil depths were established. At equivalent soil matric potentials, the hydraulic conductivity of surface soil was greater than that of the subsoil layers. Soil water diffusivity at different depths responded similarly. The study describes a simple in situ technique to measure percolation rates in wetland rice fields and evaluation of water transmission properties of field soil profiles. (Author's abstract)
W85-06685

SALT AND WATER TRANSPORT IN UNSATURATED SOIL FOR NON-CONSERVATIVE SYSTEMS,
Arizona Univ., Tucson. Dept. of Mathematics.
D. O. Lomen, P. J. Tonellato, and A. W. Warrick.
Agricultural Water Management, Vol 8, No. 4, p 397-409, February, 1984. 6 Fig, 15 Ref. OWRT project B-097-ARIZ.

Descriptors: *Solute transport, *Soil water, Aeration zone, Roots, Mathematical equations, Dispersion, Unsaturated flow.

Materials are commonly removed from soil water by adsorption to the soil particles, dissolution, plant uptake and volatilization. An analytical solution is developed for one-dimensional salt and water transport in soil systems with a steady intake velocity. Both water and solutes are non-conservative in the sense that they are removed by plant roots. The solute (or any water-transported entity) may be lost through a first order reaction. In this analytical solution, the unsaturated flow is coupled to solute uptake by the use of a 'reflection coefficient' describing selective uptake by the roots. Hydrodynamic dispersion is included in the initial formulation, but is assumed negligible in actual calculations. Four numerical examples illustrate the utility of the solution. Possible extensions include effects of solute dispersion or multidimensional flow systems. (Moore-IVI)
W85-06686

SIMULATING INFILTRATION INTO FROZEN PRAIRIE SOILS IN STREAMFLOW MODELS,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
D. M. Gray, P. G. Landine, and R.J. Granger.
Canadian Journal of Earth Sciences, Vol. 22, No. 3, p 464-472, March, 1985. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Infiltration, *Prairies, *Model studies, *Snowmelt, Soil water, Soil properties, Streamflow, Permeability, Frozen ground, Rainfall-runoff relationships, Snowmelt.

A first generation model is presented describing snow melt infiltration into frozen Prairie soils which may be interfaced with operational systems used in streamflow synthesis and forecasting. The concept on which the model is based assumes that frozen soils of a watershed can be grouped into three classes according to their infiltration potential, namely, restricted (impervious, or most of the snow-cover water equivalent goes to runoff), limited (the amount of infiltration is governed by snow-cover water equivalent and the water or ice content of the frozen soil at the time of melt), and unlimited (a soil has the ability to absorb most of the snow water). An empirical expression describing the interrelationship between snowmelt infiltration, soil moisture content, and snow-cover water equivalent for the limited case is given. The main advantages of the model are its simplicity and ease of programming; the fact that is has a physical base; it makes use of parameters that can be readily measured or observed; and it does not require an extensive data base. Water balance calculations of runoff volumes, where the model was applied to snowmelt events on a small watershed, showed the calculated volumes agreed within 17% of the measured flows. The infiltration algorithms significantly improved the performance of the National Weather Service river forecasting system-Sacramento model in synthesizing streamflow from snowmelt over that obtained with the system when its land phase subroutine was unchanged. An infiltration index approach, similar to that employed in rainfall-runoff studies, therefore may be used to describe the process in soils of limited potential in operational systems. These findings suggest an initial value of the snowmelt infiltration index equal to the infiltration potential divided by 6 or 7 days. (Baker-IVI)
W85-06702

PERCOLATION TESTS, SOIL TEXTURE, AND SATURATED HYDRAULIC CONDUCTIVITY IN LACUSTRINE SOILS IN NORTH DAKOTA,
Virginia State Dept. of Health, Richmond.
J. F. Conta, J. L. Richardson, and L. Prunty.
Journal of Environmental Quality, Vol. 14, No. 2, p 191-194, April/June, 1985. 3 Fig, 4 Tab, 25 Ref.

Descriptors: *Percolation tests, *Soil texture, *Soil properties, *Permeability coefficient, *North Dakota, Wastewater disposal, Clay.

Percolation tests were shown to be unreliable estimators of in situ saturated hydraulic conductivity (K sub sat) if the data were to be used to predict soil permeability for on-site septic disposal systems in soils with $>$ 0.35 kg/kg clay ($r = -0.38$(nonsignificant), $p = 0.01$). The wide variations in percolation rates (10.5-135.9 min/cm) measured on similar pedons with silty clay or clay textures were attributed to the pedal nature and vertic properties that exist in high clay content soils of the area. Percolation rates yielded good estimates of K sub sat in soils with $<$ 0.35 kg/kg clay ($r = -0.79$**, $p = 0.01$)(**indicates significance at the 1% level). The soil clay content and K sub sat rate correlated with sufficient precision over a wide range of soil textures for clay content to be used in predicting permeability and to permit using permeability to interpret the soil suitability for septic absorption fields. This research showed that clay content could reliably form the basis of a sanitary code. A comparison of in situ K sub sat rates and estimated permeability ranges used by the Soil Conservation revealed that many fine-textured soils have permeabilities greater than the Soil Conservation Service ranges indicate. The ranges of permeability should be expanded for these fine-textured soils to include more rapid permeabilities. (Author's abstract)
W85-06717

NOTE ON LEWIS-KOSTIAKOV'S INFILTRATION EQUATION,

Bidhan Chandra Krishi Viswa Vidyalaya, Mohanpur (India). Dept. of Agricultural Engineering.
R. K. Ghosh.
Soil Science, Vol. 139, No. 3, p 193-196, March, 1985. 2 Fig, 16 Ref.

Descriptors: *Soil water, *Infiltration, *Lewis-Kostiakov's Equation, Mathematical equations, Rainfall, Permeability, Soil properties.

Equations were evaluated for use in predicting and controlling rainwater infiltration and rainfall excess in crop and range lands. Experimental data was obtained from investigations using infiltrometers on two soil sites in situ. In analyzing the experimental data the conclusion appeared to be valid that the time exponent of Lewis-Kostiakov's infiltration equation may at some time assume a value greater than 1. The traditional notion that this exponent will always be less than or equal to 1 is shown to be unfounded. (Baker-IVI)
W85-06746

AGGREGATE BREAKDOWN IN RELATION TO RAINDROP ENERGY,
Jember Univ. (Indonesia). Faculty of Agriculture.
Wustamidin, and L. A. Douglas.
Soil Science, Vol. 139, No. 3, p 239-242, March, 1985. 2 Tab, 23 Ref.

Descriptors: *Rain, *Soil properties, *Soil aggregates, Aggregates, Infiltration, Permeability, Chemical composition, Montmorillonite, Energy.

A model was developed to relate a number of soil properties to the drop energy required to cause aggregate breakdown (D). Aggregates from 17 soils were used in the study. Aggregate breakdown was studied by allowing drops to fall 1 m through a 12 cm diameter plexiglas tube onto an air-dry aggregate placed on fiberglass gauze attached to the mouth of a glass funnel. The weight of the soil that passed through the fiberglass gauze due to the action of a recorded number of drops was used to calculate D, the amount of raindrop energy required to pass 1 g of soil through the fiberglass gauze. The model as presented enabled D to be predicted from soil properties for five out of six test soils. In the one case where the model failed, the soil differed from all others used in this study in that it contained an exceptionally high amount of montmorillonite. A positive correlation was found between soil Al hydrous oxide content and D. Organic matter content also yielded a positive correlation. The high negative charge on soil organic matter has significantly influenced the correlation result associated with cation exchange capacity. (Baker-IVI)
W85-06747

SALT REMOVAL FROM SOILS OF THE LOW SYRT PLAIN,
Volga Inst. of Hydraulic Engineering and Melioration, Engel's (USSR).
T. K. Platanova, and L. N. Shmyglya.
Soviet Soil Science, Vol. 16, No. 5, p 93-98, September/October, 1984. 3 Fig, 1 Tab, 7 Ref. Translated from Pochvovedeniye, No. 7, p 144-149, 1984.

Descriptors: *Leaching, *Salt removal, *Soil water, *Low Syrt Plain, Irrigation, Salinization, Seepage, Gypsum, Sodium hydrocarbonate.

The results of field and lab experiments on the leaching of Dark Chestnut, deeply secondarily Solonchakic soils on syrt deposits are given. The stages of salt removal are distinguished and the ways of secondary salt formation shown. Two main stages could be distinguished. The first stage is characterized by rapid, almost piston-like removal of salts from the original pore solution. The second is characterized by the secondary formation of significant quantities of salts, predominantly sodium sulfate, due to exchange reactions between the adsorbing complex and poorly dissolving, salts (gypsum and calcium carbonate). If the gypsum content in the soils is not great, the secondary formation of sodium hydrocarbonate begins. The rate of salt removal sharply decreases in the second stage. The leaching of soils to some degree imitates the conditions of long-term irrigation and therefore the physicochemical phenomena that occur in the process apparently will also appear in analogous forms in irrigated lands. In order to substantiate theoretical schemes for forecasting the salt regime of soils the potential salt supply in groundwater must be estimated. (Baker-IVI)
W85-06749

CHANGES IN SOUTHERN CHERNOZEMS AFTER DRIP IRRIGATION,
Leningrad State Univ. (USSR).
For primary bibliographic entry see Field 3F.
W85-06750

EFFECT OF DIFFERENTIAL POROSITY ON THE NATURE OF MOISTURE MIGRATION AND SALT ACCUMULATION IN SOIL (AS EXEMPLIFIED BY NEWLY DEVELOPED SOILS OF TADZHIKISTAN),
Tadzhik Scientific Research Inst. of Soil Science, Dushanbe (USSR).
T. M. Drozhzhina, and S. I. Vasil'chikova.
Soviet Soil Science, Vol. 16, No. 5, p 109-115, September/October, 1984. 4 Tab, 5 Ref. Translated from Pochvovedeniye, Vol. 4, p 71-77, 1984.

Descriptors: *Soil water, *Leaching, *Irrigation, *Soil properties, *Tadzhikistan, *USSR, Infiltration, Permeability, Clay, Chemical composition, Saline soils.

Movement of moisture in the soil profile and salt accumulation depend not only on natural and climatic factors, but also on the simultaneous presence of pores with readily mobile and difficulty mobile moisture held in pores 4-50 micro-m in diameter. The effect of differential porosity on soil moiture and salt accumulation was studied using soils in newly developed areas: the Yavan and Beshkent valleys and the Karadum region in southern Tadzhikistan. Drawing of moisture into subsoil waters, the groundwater and the downward migration of salts are largely dependent on the combination of pores with mobile moisture and passive moisture. The predominance of pores with mobile moisture ensures a leaching regime even in the presence of mineralized soil groundwaters close to the surface. Aeration porosity does not take part in raising soil moisture. In all cases the predominance of pores 4-50 micro-m in diameter in the presence of mineralized groundwater and absence of poorly permeable screens leads to salinization of the aeration zone of the Solonchak stage. (Baker-IVI)
W85-06751

INFLUENCE OF SOIL DROUGHT AND PARTIAL WATERLOGGING ON WATER RELATIONS OF GMELINA ARBOREA SEEDLINGS,
Department of Botany, University of Ibadan, Nigeria, Africa.
For primary bibliographic entry see Field 2I.
W85-06858

2H. Lakes

PREDICTION OF CHLOROPHYLL A CONCENTRATIONS IN IMPOUNDMENTS OF SHORT HYDRAULIC RETENTION TIME,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. D. Pridmore, and G. B. McBribe.
Journal of Environmental Management, Vol. 19, No. 4, p 343-350, December, 1984. 2 Fig, 1 Tab, 35 Ref.

Descriptors: *Chlorophyll a, *Reservoirs, *Hydraulic retention time, Mathematical models, Phytoplankton, Biomass, Phosphorus, Nutrients, Growing season.

A mathematical model is developed to predict growing season chlorophyll a concentrations in impoundments of short hydraulic retention time (i.e. < 2 weeks). This model is preferred for environmental management over other models, because it predicts limited rates of growth as phytoplankton biomass increases, admits simple analytical solution, includes measurements which are relatively easy and inexpensive to obtain and requires no field calibration. Growth rate is limited in the model by the inclusion of an inhibition factor, (K-B)/K, which increases in importance as the chlorophyll a concentration in the impoundment (B) approaches its theoretical maximum (K), based on an empirical relation between the maximum observed chlorophyll a concentration and growing season mean total phosphorus concentration in the euphotic waters of 82 lakes. When tested on New Zealand hydro-electric impoundments, the model was found to describe reliably both the observed chlorophyll a build-up curve and the observed steady state concentration. Further attempts to corroborate the model are encouraged. (Author's abstract)
W85-06177

LAKE ALGAL POPULATIONS AND PHYSICO-CHEMICAL CHANGES AFTER 14 YEARS INPUT OF METALLIC MINING WASTES,
Victoria Univ. (British Columbia). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W85-06221

MATHEMATICAL ANALYSIS OF OXYGEN AND NITRATE CONSUMPTION IN DEEP MICROBIAL FILMS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
S. E. Strand, and A. J. McDonnell.
Water Research, Vol. 19, No. 3, p 345-352, 1985. 3 Fig, 1 Tab, 42 Ref. NSF grant ENG7820221.

Descriptors: *Oxygen, *Nitrates, *Microbial films, *Mathematical models, Aerobic conditions, Anaerobic conditions, Diffusion, Microorganisms, Films.

The simultaneous diffusion and consumption of oxygen and nitrate into microbial films with aerobic and anaerobic layers was modeled by a system of differential equations and solved by numerical methods. Fickian diffusion was assumed. Models used Monod kinetics and zero-order kinetics, for growth limitation by oxygen and nitrate. Denitrification was assumed to be repressed by oxygen concentrations greater than a finite critical value. Both models indicate that oxygen concentration in the overlying water would have little effect on the nitrate uptake of thick films. (Author's abstract)
W85-06227

INTERACTION BETWEEN RIPARIAN VEGETATION, WATER TEMPERATURE, AND SALMONID HABITAT IN THE TUCANNON RIVER,
Agricultural Research Service, Fort Collins, CO. Hydro-Ecosystem Research Unit.
F. D. Theurer, I. Lines, and T. Nelson.
Water Resources Bulletin, Vol. 21, No. 1, p 53-64, February, 1985. 2 Fig, 7 Tab, 14 Ref.

Descriptors: *Salmon, *Steelhead, *Riparian vegetation, *Water temperature, *Tucannon River, *Washington, River restoration, Habitats, Economic aspects, Fish populations, Model studies.

The Tucannon River watershed is located in southeastern Washington. The upper third of the watershed is on public land and has enough riparian vegetation and clean substrate to serve as satisfactory salmonid spawning and rearing habitat. The lower two-thirds is on privately owned land; here the river has lost most of its vegetation and is not satisfactory for either rearing or spawning habitat. Physical-process, ecological, and economic models are used to: analyze the instream water temperatures with respect to existing and proposed riparian vegetation under natural conditions; use these water temperatures to determine salmon and steelhead fish populations that were based upon actual field count and known temperature preference data; and determine the economic worth based upon the estimated carrying capacity of the river, the estimated number of return spawners, and the economic value of commercially caught and sport-caught salmon and steelhead. The analysis demonstrates the efficacy of multidisciplinary

modeling efforts to relate riparian vegetation, water temperature, and salmonid habitat. The economic results clearly indicate the value and feasibility of restoring riparian vegetation on the Tucannon River. The total cost for restoring the entire thermal regime would be less than 1.5 million dollars, as contrasted to the present worth of 6.9 million dollars. (Moore-IVI)
W85-06239

CHARACTERIZATION OF SEDIMENT REFERENCE MATERIALS BY X-RAY PHOTOELECTRON SPECTROSCOPY,
National Inst. for Environmental Studies, Tsukuba (Japan).
M. Soma, H. Seyama, and K. Okamoto.
Talanta, Vol. 32, No. 3, p 177-181, March, 1985. 3 Fig, 3 Tab, 24 Ref.

Descriptors: *Sediment-water interfaces, *Chemical composition, Estuarine sediments, Pond sediments, River sediments, Silicon, Chromium, Organic matter, Binding energy.

The chemical composition of surface layers of three sediment reference materials, Pond Sediment (Japan NIES CRM No. 2), River Sediment (US NBS SRM 1645) and Estuarine Sediment (US NBS SRM 1646), has been studied comparatively by X-ray photoelectron spectroscopy (XPS). The composition of River Sediment as determined by XPS is peculiar in that the concentration of Cr is much higher but that of Si is much lower than that expected from the bulk composition of the sample. This can be attributed to the structure of the sediment particles, which consist of silica-rich cores covered by surface layers rich in Cr(III). Organic substances are predominant in the surface layers of all three materials, as indicated by the C 1s and N 1s lines. The elemental composition of the surface layers can be reasonably related to the origin of the sediments. The bonding states of some elements in the sediment samples, deduced from the photoelectron binding energies, are briefly discussed. (Author's abstract)
W85-06250

OXYGEN BUDGET OF THE WATERS OF THE FELDBERGER LAKEPLAIN BASED ON SUMMER DEPTH PROFILES FOR 1924 AND 1962, PART 3: SCHARTEISEN, WASCH-SEE, DOLGENER SEE (ZUM SAUERSTOFFHAUSHALT DER GEWASSER DER FELDBERGER SEENPLATTE AN HAND AUSGEWAHLTER SOMMERLICHER TIEFENPROFILE SEIT 1924 UND 1962, TEIL 3: SCHARTEISEN, WASCH-SEE, DOLGENER SEE),
For primary bibliographic entry see Field 5C.
W85-06274

STABILITY OF THE STATIONARY STATE OF A EUTROPHIC WATER POOL,
Bulgarian Academy of Sciences, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika.
For primary bibliographic entry see Field 5C.
W85-06277

MATHEMATICAL REPRESENTATION OF SHORT TERM PHOSPHORUS VARIATIONS IN A NON-STRATIFIED SOUTHERN LAKE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
C. E. Mericas, and R. F. Malone.
Environmental Monitoring and Assessment, Vol. 4, No. 1, p 85-98, March, 1984. 10 Fig, 1 Tab, 12 Ref.

Descriptors: *Eutrophic lakes, *Mathematical models, *Phosphorus, *Crest Lake, *Louisiana, Lake restoration, Siumlation, Seasonal variation, Rainfall, Wind.

Total phosphorus concentrations in a small urban hypereutrophic lake undergoing restoration were continually modeled by a modified version of a Vollenweider model for the latter part of the three and one-quarter year restoration period. Results of the modeling effort on Crest Lake (Louisiana) were analyzed to determine the compatibility of the basic Vollenweider model with short term applications to highly eutrophic southern lakes. Input parameters such as rainfall and wind speed were considered on a daily basis to see if the model could represent the short term variations observed in the lake. Model simulations were compared to total phosphorus observations collected on the lake at intervals as short as one day. Results indicated that the model can be used as a tool for analysis of system responses on a seasonal basis, but short term variations on the weekly or daily timeframe were poorly represented by the model. Intensive temporal and spatial sampling within the lake verified the validity of the completely mixed assumption for short term applications. Nine sampling locations within the lake, distributed with area and depth, displayed a mean coefficient of variation of only 10.9% when averaged daily for the 54 day intense sampling period. Short term variations were poorly correlated with meterological inputs, suggesting that variability be best represented by a stochastic approach if a practical management tool is desired for situations where variabilty is critical. The seasonal trends were well represented by the model, reflecting the rapid response by hypereutrophic systems to alterations in phosphorus loadings. (Author's abstract)
W85-06285

CHANGES IN IONIC DISTRIBUTIONS IN FINNISH LAKE WATER DURING THE PERIOD 1968-1983,
For primary bibliographic entry see Field 5C.
W85-06296

APPLICATION OF THE FINNECO MODEL TO LAKE PYHAJARVI,
J. Niemi, and J. Eloranta.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 77-96, 1984. 14 Fig, 4 Tab, 17 Ref.

Descriptors: *Model studies, *Water quality, *Lake Pyhajarvi, *Finland, Eutrophic lakes, Phytoplankton, Wind, Simulation, Computer models.

The FINNECO lake model is a one-dimensional water quality simulation model developed in a joint project between the National Board of Waters, Finland and International Business Machines, Finland during the years 1978-1981. The model has eighteen state variables, includes the effect of wind in mixing water and simulates the freeze-up and break-up of ice on the basis of energy balance. The model was applied to the eutrophic Lake Pyhajarvi situated in southern Finland. Calibration was carried out by a trial and error method using the data of the open water season of 1980. Using the same parameter combination and the corresponding data of 1981, the agreement between the model output and observations was poor and the model could not be considered as verified. However, reasonably good agreement was obtained with this set of data by changing the values of only five parameters. It can be concluded that the model is unable to simulate water quality accurately in the lake as eutrophic as Lake Pyhajarvi. The sensitivity of the model to the input data was also tested. When the input data was given to the model as weekly or monthly averages instead of once every eight hours the values of most state variables, except those of phytoplankton, did not change markedly. This shows that the interval between individual input data can be longer than eight hours, which simplifies the application of the model and decreases computer costs. (Author's abstract)
W85-06298

EFFECT OF ASH FALLOUT ON WATER QUALITY IN WESTERN MONTANA,
Montana Univ., Missoula. Dept. of Chemistry.
For primary bibliographic entry see Field 5C.
W85-06325

AERATION-DESTRATIFICATION OF LAKE EUREKA: SECOND YEAR OPERATION,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5G.
W85-06344

MICROSYSTEM SEDIMENT-WATER SIMULATION: A PRACTICAL TECHNIQUE FOR PREDICTING RESERVOIR WATER QUALITY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5B.
W85-06358

STUDIES ON DESTRUCTION OF ORGANIC SUBSTANCE OF HIGHER AQUATIC PLANTS BY LABORATORY WATER COURSE MODELS (IZUCHENIE DESTRUKTSII ORGANICHESKOGO VESHCHESTVA VYSSHIKH VODNYKH RACTENII NA LABOPATORNYKH MODELYAKH VODOTOKOV),
For primary bibliographic entry see Field 2K.
W85-06376

ELODEA IN LAKE BAIKAL (ELODEYA KANADSKAYA V OZ.BAIKAL),
O. M. Kozhova, V. N. Pautova, and S. S. Timofeeva.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 82-84, 1985. 11 Ref.

Descriptors: *Elodea, *Lake Baikal, *Angara River, *USSR, Aquatic plants, Phenols, Aliphatic amines, Cyanide, Hydrocarbons, Enzymes, Biofilters, Distribution.

The Elodea distribution in Lake Baikal (USSR) and in Angara River is reported. The results of the authors' observations and data available in literature are presented. Elodea is found to be stable to the effects of phenol, aliphatic amines, cyanide and petroleum hydrocarbons. The oxidoreductase activity is determined, and a conclusion is presented on the advisability of its use as a biofilter as well as on the value of Elodea distribution for the natural state of Lake Baikal. (Author's abstract)
W85-06380

ORTHOPHOSPHATE UPTAKE OF PLANKTONIC MICROORGANISMS IN LAKE BALATON,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
V. Istvanovics, and S. Herodek.
Hydrobiologia, Vol. 122, No. 2, p 159-166, 1985. 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Plankton, *Lakes, *Phosphates, *Orthophosphates, *Lake Balaton, Absorption, Eutrophication, Model studies, Microorganisms, Seasonal variation.

Seasonal orthophosphate uptake of natural plankton has been studied in hypertrophic and mesotrophic basins of Lake Balaton. Radioactivity of labelled phosphorus first decreased rapidly in filtrates of unenriched samples over time, and became constant afterwards. Uptake can be described by a simple two-compartment model between plankton and media. The model predicts isotope equilibrium between particulate and dissolved phases and first order kinetics for initial decrease of activity in filtrate. Turnover times in water of Lake Balaton were short and seasonally different. The shortest values were obtained in summer. Turnover times were longest in winter, under ice-cover and at the end of April. Rapid turnover of orthophosphate in water does not mean a similarly rapid turnover of planktonic phosphorus. Turnover time of phosphorus in microorganisms has been estimated on the basis of equilibrium isotope distribution between water and particular phases and turnover time in water. It ranged from 28 to over 1,000 min. Turnover time of orthophosphate in water increased in relation to phosphate additions according to Michaelis-Menten kinetics. The values of Michaelis-constant plus the ambient orthophosphate concentration suggested an overestimation of real phosphate concentration by chemical measurements, being much lower than soluble reactive phosphorus content in most cases, as it is well known in many other lakes. (Baker-IVI)
W85-06389

CARBON FLOW IN THE PELAGIC ZONE OF A SHALLOW TURBID IMPOUNDMENT, WURAS DAM,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
J. U. Grobbelaar.
Archiv fur Hydrobiologie, Vol. 103, No. 1, p 1-24, March, 1985. 12 Fig, 7 Tab, 29 Ref.

Descriptors: *Reservoirs, *Turbidity, *Carbon cycle, *Wuras Dam, *South Africa, Dams, Turbidity, Pelagic zone, Phytoplankton, Flooding, Primary productivity.

Carbon flow within the pelagic zone of a shallow turbid man-made impoundment, Wuras Dam (South Africa) was measured during intensive 24 or 48 hour studies over a two year period. The Wuras Dam system was seen as a close-knit system in which the various components are heavily dependent on each other. Primary production by the phytoplankton provides the major source of organics to the system and any factor which influences this would influence the entire system. The underwater light climate and the thermal regime were identified as the two most important factors influencing phytoplankton productivity. The underwater light climate is directly influenced by the suspensoids which therefore, has an influence on the entire system. Flooding and the consequent throughflow of water has a marked influence in a shallow system such as Wuras Dam, where the components of the pelagic zone are washed out. The system appears to stabilize relatively quickly after such major disturbances. (Baker-IVI)
W85-06391

POSTGLACIAL CHANGES IN ALGAL AND CLADOCERAN ASSEMBLAGES IN LITTLE ROUND LAKE, ONTARIO,
Queen's Univ., Kingston (Ontario). Dept. of Biology.
J. P. Smol, and M. M. Boucherle.
Archiv fur Hydrobiologie, Vo. 103, No. 1, p 25-49, March, 1985. 11 Fig, 34 Ref. Natural Sciences and Engineering Research Council of Canada grant A-0808.

Descriptors: *Algae, *Cladocerans, *Little Round Lake, *Ontario, Stratigraphy, Species composition, Water temperature, Erosion, Nutrients, Hemlock trees, Trophic level.

Stratigraphic changes in algal and cladoceran assemblages were described from the postglacial sediments of Little Round Lake, a small, meromictic, alkaline lake in southeastern Ontario, Canada. The shifts recorded in species composition and abundance were attributed to a variety of factors, including low temperatures during the lake's early history, watershed processes regulating erosion and nutrient release, and variations in the lake's meromixis. In contrast to other lakes that have been studied in the region, the return of hemlock (Tsuga canadenis) about 3,000 years ago to the lake's catchment did not result in a return to more oligotrophic conditions. Instead, the changes in algal and cladoceran microfossils indicate fluctuations in trophic status that are attributed to episodes of increased entrainment of nutrient-rich water from the monimolimnion. (Author's abstract)
W85-06392

IMPLICATIONS OF SLOW DEEP WATER RENEWAL OF LAKE KOENIGSSEE DERIVED FROM COMBINED TRITIUM-3HELIUM MEASUREMENTS,
Heidelberg Univ. (Germany, F.R.). Inst. fuer Umweltphysik.
K. H. Fischer, W. Weiss, O. Siebeck, and R. Muller.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 409-414, February, 1985. 1 Fig, 9 Ref.

Descriptors: *Lake Konigssee, *Turnover time, *Tritium, *Helium isotopes, Mixing, Diffusion, Gas exchange, Thermoclines, Temperature effects.

Two vertical tritium and helium-3 profiles fom December 1980 and September 1981 taken at a station near the deepest point of Lake Konigssee are presented. The tritium profiles indicate that water inflow by rivers is concentrated at shallow depth. The deep water renewal rate by inflowing rivers during winter 1980/81 deduced from tritium data is 10%, which corresponds to a water turnover time of 10 years. The deep water net oxygen consumption rate, that is based on the tritium - helium-3 age, amounts to 0.07 mg/l/month. Helium-3 gas exchange rates of 0.2 m/d during winter 1980/81 and 0.02 m/d during summer 1981 are calculated from the data. From the September 1981 profile a vertical eddy diffusion coefficient for tritium, helium-3 and temperature of 0.03 cm sq/sec is derived from the depth range between 6 m and 21 m, i.e. directly below the thermocline. These findings show that tritium - helium-3 measurements are a powerful tool for the study of the mixing behavior of lakes. The exceptionally small gas exchange rates found in Lake Konigssee may be caused by its particular geographical situation surrounded by high mountains, which protect the lake surface from strong winds. The tritium - helium-3 measurements in Lake Konigssee demonstrate only a weak regeneration capability of the deep water of the lake. Consequently Lake Konigssee represents an extremely sensitive ecosystem, which even with relatively small loads of nutrients is in danger of collapsing. (Baker-IVI)
W85-06395

TRANSFORMATIONS OF NITROGEN FOLLOWING AN EPILIMNETIC NITROGEN FERTILIZATION IN CASTLE LAKE, CA: 1. EPILITHIC PERIPHYTON RESPONSES,
California Univ., Davis. Div. of Environmental Studies.
J. E. Reuter, S. L. Loeb, R. P. Axler, R. G. Carlton, and C. R. Goldman.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 425-433, February, 1985. 2 Fig, 1 Tab, 20 Ref. NSF grant DEB 80-19918.

Descriptors: *Castle Lake, *California, *Nitrogen fixation, *Periphyton, Ammonia, Nitrates, Epilimnion, Algae, Dissolved solids.

Changes in inorganic nitrogen metabolism of a nitrogen fixing periphyton community were measured following an epilimnetic addition of NH4NO3 to N-deficient Castle lake, California in August of 1980 and 1981. Ambient concentrations of both ammonium and nitrate were reduced to pre-addition levels in 30 days in 1980 while these substrates were depleted in 16 and 26 days in 1981, respectively. The elevated dissolved inorganic-N (DIN) concentrations did not suppress nitrogenase activity and rates of nitrogen fixation were statistically similar during the pre- and post-addition periods. DIN levels > 700 micro-g NO3(-)-N and 70-700 micro-g NH4(+)-N/liter were needed to totally inhibit nitrogen fixation. Under normal growing season conditions of low DIN nitrogen fixation is the major pathway for inorganic N incorporation. At ammonia-N and nitrate-N levels < 45 micro-g/liter, these substrates were assimilated simultaneously with no apparent preferential utilization. The ratios of ammonia to nitrate ions uptake ranged from 0.66 to 2.46. Since nitrogenase activity was not suppressed by a 20-fold DIN enrichment and since ammonia and nitrate were simultaneously assimilated, epilithic periphyton in Castle Lake are N-deficient and dependent upon N2-fixation during the summer when ambient DIN levels are extremely low. (Baker-IVI)
W85-06397

OBSERVATIONS ON THE PHYTOBENTHOS OF THE FRESHWATER THAMES; I. THE ENVIRONMENT, FLORISTIC COMPOSITION AND DISTRIBUTION OF THE MACROPHYTES (PRINCIPALLY MACROALGAE),
British Museum of Natural History, London (England). Dept. of Botany.
D. M. John, and J. A. Moore.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 435-459, February, 1985. 3 Fig, 5 Tab, 34 Ref.

Descriptors: *Aquatic plants, *Benthic flora, *Thames, *England, Ecological distribution, Algae, Bryophytes, Seasonal variation, Macrophytes, Locks, Sluices, Weirs, Boats, Navigation.

The Thames is one of the most important lowland rivers in the British Isles, which much of its main watercourse engineered for navigation. This is the first general account of the composition, seasonality, and distribution of the benthic algae forming evident macroscopic growths in this lowland, hard-water river in southern England; some consideration is also given to other aquatic macrophytes. The headwater is fed by springs and flows for about nine months each year; a diverse and luxuriant aquatic vegetation develops rapidly on the river bed as the water level drops each spring in the seasonally-flowing headwater. Various assemblages of aquatic macrophytes develop further downriver in the permanently-flowing section that is too shallow for motor cruisers. Few plants occur on the bed of the very long and deep navigable section, except in the marginal shallow and on the floor of sluice channels and weir steps. In this section of the river, algae and bryophytes commonly form a band along the bank when the water level stabilizes for several weeks in summer. Such bands also develop in the sides of lock pounds, and on walls wetted by splash and spray. Local factors which influence the height and pattern of zonation include wash from boats, the nature of the substratum, and frequency of opening the sluices. (Moore-IVI)
W85-06398

UPTAKE OF CARBON AND INORGANIC NITROGEN IN A EUTROPHIC LAKE, LAKE NAKANUMA, JAPAN, FROM SPRING THROUGH SUMMER,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
T. Miyazaki, Y. Honjo, and S. Ichimura.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 473-485, February, 1985. 6 Fig, 1 Tab. 32 Ref.

Descriptors: *Carbon, *Nitrogen, *Eutrophic lakes, *Lake Nakanuma, *Japan, Seasonal variation, Ammonium, Nitrites, Nitrates, Carbon isotopes, Nitrogen isotopes, Particulate matter.

Sampling was done in a freshwater, eutrophic lake, Lake Nakanuma, Japan. The surface area and maximum depth of this lake are 1.3 ha and 13 m, respectively. Carbon and inorganic nitrogen uptake were measured simultaneously by the C-13 and N-15 method. Carbon uptake activity in the 1 m layer was 3.8 micro-g C/l/h in spring and 34 micro-g C/l/h in the summer stagnation period. Ammonium was most effectively incorporated into particulate matter fraction, followed by nitrate and nitrite. The activity of ammonium uptake in the layer ranged from 43 ng at N/l/h in spring to 216 ng at N/l/h in the summer stagnation period. Dark uptake of ammonium was 22-66% of light uptake in the 1 m layer. This percentage was higher than that of dark uptake of carbon. The difference between carbon and nitrogen uptake suggests that the uptake mechanism of carbon was different from that of nitrogen. (Moore-IVI)
W85-06400

SPECIES COMPOSITION, TEMPORAL ABUNDANCE AND COMMUNITY STRUCTURE OF ZOOPLANKTON IN LAKE SATTAL (U.P.), INDIA,
D.S.B. Constituent Coll., Naini Tal (India). Dept. of Zoology.
M. C. Pant, A. Joshi, and P. C. Sharma.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 519-535, February, 1985. 6 Fig, 6 Tab, 28 Ref.

Descriptors: *Species composition, *Zooplankton, *Lake SatTal, *India, Copepods, Rotifers, Cladocerans, Species diversity, Phytoplankton, Biomass, Trophic level.

Out of 22 species of zooplankton, only four species viz., Mesocyclops leuckarti, Daphnia similis, Anuraeopsis fissa and Keratella tropica were dominant in terms of number. The species composition and number reflected the characteristics of both temperate and tropical areas in Lake SatTal (India). Copepod and rotifers showed their peak abundance from August through October and remain segregated in 3-5 m water column; whereas cladocerans which peaked during winter tended to be

concentrated in the deeper strata (10-15 m) of the lake. The diversity was low due to dominance of only few species. The mean annual phytoplankton ratio to zooplankton biomass (P/Z) was 1.00 and 3.89 in western and eastern basins respectively. However, the resource partitioning between second and first trophic levels was not inefficient but energy transfer was more efficient between herbivores and primary carnivore. (Author's abstract)
W85-06401

STRIPED BASS MANAGEMENT IN LAKES WITH EMPHASIS ON MANAGEMENT PROBLEMS,
Kentucky Dept. of Fish and Wildlife Resources, Frankfort.
J. R. Axon, and D. K. Whitehurst.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 8-11, January, 1985. 3 Ref.

Descriptors: *Striped bass, *Fish management, *Water pollution effects, *Reservoir fisheries, Reservoirs, Dissolved oxygen, Thermal stress, Thermal pollution, Habitats.

The number of fisheries for striped bass Morone saxatilis in freshwater impoundments in the United States has increased dramatically over the last decade. A survey of fisheries agencies throughout the country was conducted to evaluate accomplishments and problems associated with management of striped bass and hybrid striped bass (male white bass Morone chrysops x female striped bass). Through 1981, fisheries for striped bass, hybrid striped bass, or both had been established in at least 279 lakes in 34 states. Mean annual harvest rates from striped bass, hybrid striped bass, and mixed (both fish in same lake) fisheries were 1.1, 0.7, and 3.0 kg/hectare, respectively. In reservoirs where they are established, these fisheries contribute an average of 13.6% to the total harvest by weight; their maximum contribution is 66.2%. Improvements in management have been limited by the lack of good objectives and of quantitative evaluations of stocking success. The most frequently cited management problem was mortality of adult striped bass due to thermal stress and to low dissolved oxygen concentrations. Other major problems included inadequate prey availability, emigration, predation on salmonids, and variable survival of introduced fish. Management potential can be greatly enhanced by additional information on the habitat requirements and predator-prey relations of these fish in impoundments. (Author's abstract)
W85-06402

SUMMER SELECTION OF THERMAL REFUGES BY STRIPED BASS IN ALABAMA RESERVOIRS AND TAILWATERS,
Alabama Dept. of Conservation and Natural Resources, Montgomery. Game and Fish Div.
J. L. Moss.
Transactions of the American Fisheries Society, Vol. 114, p 77-83, 1985. 2 Fig, 1 Tab, 13 Ref. Federal Aid in Fish Restoration project F-38.

Descriptors: *Striped bass, *Water temperature, *Fish behavior, *Reservoirs, *Alabama River, *Alabama, Ecological distribution, Habitats, Thermal refuges, Reservoir fisheries, Seasonal variation.

Routine sampling for striped bass in Alabama reservoirs during summer months was unsuccessful until June 1979 when adult striped bass were discovered concentrating in two spring-fed tributaries along the Alabama River. One area was 0.6 km below Millers Ferry Dam and the other was 0.6 km below Jones Bluff dam. Adult and subadult striped bass began concentrating in the spring-fed tributaries of the Alabama River in early June as ambient river temperatures approached 27 C. Fish collected from summer refuges had lower condition factors than those collected during April through May. Six striped bass (2.7-5.9 kg) equipped with ultrasonic and radiotelemetry transmitters tended to seek cool-water refuges (22-26 C) in reservoirs during summer, but they tolerated temperatures 5-6 C higher during excursions of several hours from or between refuges. If thermal refuges are important to the success of striped bass in southern reservoirs, they may control the carrying capacity of the system. (Moore-IVI)
W85-06407

DEPTH DISTRIBUTION OF STRIPED BASS AND OTHER FISH IN LAKE TEXOMA (OKLAHOMA-TEXAS) DURING SUMMER STRATIFICATION,
Oklahoma Univ., Kingston. Biological Station.
W. J. Matthews, L. G. Hill, and S. M. Schellhaass.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 84-91, January, 1985. 3 Fig, 18 Ref. DOE contract 14-16-009-82-018.

Descriptors: *Stratification, *Population density, *Seasonal variation, *Fish, *Lake Texoma, *Oklahoma, *Texas, Lakes, Water depth, Oxygen depletion.

In May and June 1982, before stratification, echolocator charts indicated that fish in the main basin of Lake Texoma (Oklahoma-Texas) were distributed from the surface to the bottom. With the onset of stratification and oxygen depletion in the hypolimnion in July, fish moved upward in the waters column, avoiding anoxic conditions near the bottom. Stratification (defined more conspicuously by dissolved oxygen and conductivity than by temperature) became progressively more distinct in late summer, and by August temperatures in the epilimnion were greater than 28 C and dissolved oxygen in the hypolimnion was less than 2 mg/liter. Echolocator charts indicated that fish were concentrated immediately above the chemocline (8-12 m deep) where water temperature was 28.5 C and dissolved oxygen was 7.2 mg/liter. This concentration of fish included subadult and adult striped bass Morone saxatilis, which are known to congregate in the main basin of Lake Texoma during the summer. Despite the high temperatures in the epilimnion, and low oxygen conditions in the hypolimnion, no mortality of adult striped bass was observed. Although the available data indicate that the temperature-oxygen 'squeeze' is typical in Lake Texoma in numerous summers, the reservoir has a large population of striped bass with many individuals larger than 5 kg. (Author's abstract)
W85-06408

UPTAKE OF PHOSPHATE AND INORGANIC NITROGEN BY A SEDIMENT-ALGAL SYSTEM IN A SUBARCTIC LAKE,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
S. Bjork-Ramberg.
Freshwater Biology, Vol. 15, No. 2, p 175-183, April, 1985. 5 Fig, 2 Tab, 35 Ref.

Descriptors: *Lake Gunillajaure, *Sweden, *Phosphates, *Nitrogen, *Phytoplankton, Absorption, Nutrients, Limnology, Stratification, Lake sediments, Algae.

Phosphate and inorganic nitrogen uptake by sediment and phytoplankton was studied under natural conditions in 1977 and during lake fertilization with phosphorus and nitrogen (1978-79) in Lake Gunillajaure, a small, stratified, subarctic lake in northern Sweden. The experiments were performed in situ in plexiglass cylinders, to which additions of nutrients were made, and the uptake followed by consecutive sampling and analysis of the water phase. Addition of HgCl2 to the experimental vessel inhibited phosphate uptake to the sediment very effectively, suggesting that the uptake by the sediment of Lake Gunillajaure was biological for the most part and that physical-chemical sorption was of minor importance. Phosphate uptake in the dark by the sediment was 30-40% of that in tubes exposed to light. Since light clearly stimulated the uptake it was probably the epipelic algae that dominated this procedure. A comparison of half-saturation constants for phosphate uptake by phytoplankton, both cultured and natural, and the epipelic algae of Lake Gunillagaure was performed. The epipelic algae and not the bacteria dominated the phosphate uptake. The uptake of ammonia-N and nitrate-N by the sediment was very slow indicating that the epipelic algae were not nitrogen-starved and perhaps that the nitrogen pool in the sediment was available to the algae. Even though the algae on the sediment apparently took up phosphate extensively and efficiently, phytoplankton took between 92% and 96% of the phosphate added on each fertilization. This was mainly an effect of the morphometry of Lake Gunillajaure which makes the water volume:sediment surface area in the epilimnion layer high and gives the phytoplankton competitive advantage over the epipelic algae. Even though the epipelic algae had a potential for efficient uptake of phosphorus, the phytoplankton took up 92-96% of the phosphate added to the lake on each fertilization occasion due to the relatively large water volume in the epilimnion in relation to the bottom area available for the epipelic algae. (Baker-IVI)
W85-06415

STABLE CARBON ISOTOPE RATIOS OF FISH AND THEIR INVERTEBRATE PREY IN FOUR NEW ZEALAND RIVERS,
Institute of Nuclear Sciences, Lower Hutt (New Zealand).
J. S. Rounick, and B. J. Hicks.
Freshwater Biology, Vol. 15, No. 2, p 207-214, April, 1985. 5 Tab, 17 Ref.

Descriptors: *Fish, *New Zealand, *Rivers, *Invertebrates, *Carbon isotopes, Carbon cycle, Food chain, Nutrients, Trout.

Sources of carbon utilized by invertebrates and fish in four New Zealand streams were investigated using stable carbon isotope analysis. A prerequisite for the use of stable isotope techniques in food-chain studies is an understanding of the amount of C13-fractionation (either enrichment or depletion) which normally occurs between food source and consumer. A second prerequisite for studies of this kind is that a measurable isotopic distinction exists between potential food sources. Utilization of carbon inputs by invertebrates showed some variation. The delta-C-13 values of invertebrates from the shaded HRB site were unusually enriched in C-13 relative to those from other studied forest streams in New Zealand. The cause of this additional C-13 enrichment relative to local C3 vegetation is unclear, but it is likely that an additional unknown C-13 enriched carbon source is contributing to the diet of the resident invertebrates. The delta-C-13 values for fish were not closely linked to aquatic invertebrate ratios. Instead, at all sites their carbon was isotopically similar to terrestrial organic carbon. (Baker-IVI)
W85-06416

ALKALINE PHOSPHATASE ACTIVITY AND CELLULAR PHOSPHORUS AS AN INDEX OF THE PHOSPHORUS STATUS OF PHYTOPLANKTON IN MINNESOTA LAKES,
Minnesota Univ., Minneapolis. Dept. of Botany.
M. A. Gage, and E. Gorham.
Freshwater Biology, Vol. 15, No. 2, p 227-233, April, 1985. 2 Fig, 1 Tab, 31 Ref.

Descriptors: *Alkaline phosphatase, *Phosphorus, *Phytoplankton, *Minnesota, *Lakes, *Lake Josephine, Nutrients, Seasonal variation, Organic matter, Stratification.

Nine lakes were investigated during 1975 in Clearwater and Hubbard Counties, Minnesota, one of them (Lake Josephine) throughout the year and the others during straification in late summer and early autumn. Total alkaline phosphatase activity is inversely related to cellular phosphorus in the particulate organic matter on waters above and below the thermocline in the nine lakes. Diagnostic criteria for assessing surplus and limiting levels of phosphorus, when applied to seasonal changes in phosphorus status in Lake Josephine, demonstrate severe phosphorus starvation in late summer and autumn. (Baker-IVI)
W85-06418

ECOLOGY OF THE SULDALSLAGEN RIVER IN WESTERN NORWAY BEFORE ITS REGULATION,
Oslo Univ. (Norway). Zoological Museum.

A. Lillehammer.
Fauna Norvegica, Vol. 5, p 22-30, 1984. 7 Fig, 3 Tab, 19 Ref.

Descriptors: *River Suldalslagen, *Rogaland, *Norway, Macroinvertebrates, Seasonal variation, Biomass, Ecology.

The River Suldalslagen, 22 km in length, situated in Rogaland province in western Norway, has been studied over a period of four years. The macro-invertebrate benthos was low in abundance especially in August and September. The main biomass was contributed by large case-bearing caddis-fly larvae, such as Potamophylax latipenis, which are shredders. The fauna composition of the upper and lower reaches of the river differed widely. Filter feeders, such as the caddis fly Polycentropus flavomaculatus, occurred in large numbers below the lake outlet, while shredders were predominant in the lower reaches. Large quantities of planktonic Crustacea, washed out to the Suldalsvatn Lake, were present in the river during the summer months. The Suldalslagen river is primarily a recruitment area for salmon and sea trout. Interestingly, the diet of the young salmonids did not show a close relationship to the available invertebrate biomass. For example, young salmon almost completely neglected the large caddis-fly larvae, while planktonic Crustacea washed out from Suldalsvatn and adult insects were taken in large numbers. A large proportion of the food supplies of both the salmon fry and parr were thus produced outside the river system. In 1962, for example, 34% of the food of the parr and 43% of that of the fry was produced in other ecosystems than the river one. (Author's abstract)
W85-06442

QUANTITATIVE ESTIMATES AND COMMUNITY STRUCTURE OF INVERTEBRATES IN A MACROPHYTE RICH STREAM,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
T. M. Iversen, J. Thorup, T. Hansen, J. Lodal, and J. Olsen.
Archiv fur Hydrobiologie, Vol. 102, No. 3, p 291-301, Januray, 1985. 4 Tab, 18 Ref.

Descriptors: *Invertebrates, *Susa River, *Denmark, Fauna, Macrophytes, Vegetation.

The invertebrate fauna of the Danish river Susa was split up into two components: the vegetation fauna and the benthic fauna. These were sampled separately. Numbers of invertebrates/g macrophyte differed in some invertebrate taxa significantly between the three species of macrophyte studied. In July 1979 a total population of 450,000 ind./sq m was estimated, most of which were found in the vegetation (95%). Chironomidae made up 79% of the fauna. Filter feeders and epiphytic grazers were the dominant functional groups in the invertebrate community. (Author's abstract)
W85-06443

CHEMICAL STATE OF FOREST SPRINGS IN THE KAUFUNGER WALD (CHEMISCHER ZUSTAND VON QUELLEN IM KAUFUNGER WALD),
Goettingen Univ. (Germany, F.R.). Abt. Bodenkunde und Waldernahrung.
J. Puhe, and B. Ulrich.
Archiv fur Hydrobiologie, Vol. 102, No. 3, p 331-342, January, 1985. 9 Fig, 1 Tab, 21 Ref.

Descriptors: *Kaufunger Wald, *Saxony, *Chemical analysis, Springs, Forests, Water analysis, Organic carbon, Acidity, Metals, Nitrates, Sulfates, Phosphates, Water quality.

In the Kaufunger Wald in southern Lower Saxony the cation and anion composition of springs emerging in forests has been investigated. The chemical analysis covered pH, organic carbon Na, NH4, K, Mg, Ca, Al, Mn, Fe, Zn, Cu, Pb, Cd, and the anions Cl, NO3, SO4 and PO4. The springs on the exposed west side of this hill area emerge from acidified soil layers; with pH values around 3.7 they are strongly acidic and contain Al and heavy metals. Aquatic life seems to have no chance in these waters. The east side springs which pass through deeper layers have a good quality. (Author's abstract)
W85-06444

APPLICABILITY OF THE STABLE ISOTOPE METHOD USING 13C AND 15N SIMULTANEOUSLY TO THE ESTIMATION OF CARBON AND NITROGEN ASSIMILATION IN A EUTROPHIC, FRESHWATER LAKE, LAKE NAKANUMA, JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
T. Miyazaki, Y. Honjo, and S. E. Ichimura.
Archiv fur Hydrobiologie, Vol. 102, No. 3, p 355-365, January, 1985. 6 Fig, 2 Tab, 22 Ref.

Descriptors: *Lake Nakanuma, *Japan, *Phytoplankton, Carbon, Nitrogen, Lakes, Eutrophic lakes.

Simultaneous measurements of carbon and nitrogen uptake were applied to a eutrophic, freshwater lake, Lake Nakanuma, Japan. Stable isotopes 13C and 15N, were used to measure the amounts and isotope ratios of carbon and nitrogen simultaneously with a quadrupole mass spectrometer equipped with a combustion furnace. Addition of inorganic nitrogen (ammonium, nitrite, nitrate) did not affect the uptake activity of acrbon. Similarly, the addition of sodium bicarbonate did not influence the nitrogen uptake activity. One possible explanation for the results is that in situ concentrations of total carbon dioxide and inorganic nitrogen were in the range of saturation uptake. Comparison of C:N assimilation ratios and C:N ratios of particulate matter suggests that carbon and nitrogen metabolisms were not necessarily closely linked to each other. The results indicate that the application of the stable isotope method is useful to studies on phytoplankton in freshwater systems. (Baker-IVI)
W85-06445

SPECIES COMPOSITION OF ZOOPLANKTON IN TWO KUMAUN HIMALAYAN LAKES (U.P., INDIA),
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
P. C. Sharma, and M. C. Pant.
Archiv fur Hydrobiologie, Vol. 102, No. 3, p 387-403, January, 1985. 4 Fig, 6 Tab, 43 Ref.

Descriptors: *Zooplankton, *Lakes, *Himalayan lakes, Species composition, Rotifers, Copepods, Seasonal variation, Population diversity, Littoral zone.

The species composition of zooplankton in two Kumaun Himalayan lakes has been determined on the basis of year round samples. A total of 88 species comprising 66 Rotifera, 7 Copepoda and 15 Cladocera were collected and identified during the course of the present investigation. Zooplankton assemblage exhibited a type of seasonality closer to a temperate situation yet the species diversity and limnetic species composition reflected the characteristics of tropical or subtropical water bodies. The littoral zone harbored a greater variety of organisms compared to limnetic ones in both the lakes. The Qualitative Similarity Index (QSI) reflected a higher degree of similarity between the two lakes. QSI worked out between different zones displayed a higher degree of similarity (0.96) between the limnetic zones, as compared to littoral ones (0.82) of the two lakes. A succession of rotifer species with the march of the season was also discussed. A well defined correlation of two parameters, namely temperature and food with the total zooplankton species was found in the two lakes. The differences in the organic enrichment of the two lakes seemed to influence their species composition. (Author's abstract)
W85-06446

VERTICAL DISTRIBUTION OF ZOOPLANKTON AND PHYSICO-CHEMICAL CONDITIONS DURING A 24-HOUR PERIOD IN AN AMAZON FLOODPLAIN LAKE - LAGO CALADO, BRAZIL,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
T. R. Fisher, J. M. Melack, B. Roberston, E. R. Hardy, and L. F. Alves.
Acta Amazonica, Vol. 13, No. 3-4, p 475-487, July, 1983. 6 Fig, 1 Tab, 29 Ref.

Descriptors: *Lake Lago Calado, *Brazil, *Vertical distribution, *Zooplankton, Physicochemical properties, Crustaceans, Water level, Anoxic conditions, Oxygen, Thermocline.

In May 1980 Lago Calado was 9 meters deep, the water level was rising slowly, and below 4 meters the water was anoxic. Virtually all of the zooplankton was in the oxygenated layer. Adult and juvenile Daphnia gessneri, the most abundant crustacean species, occurred between 0.5 and 4.5 meters. Copepod nauplii tended to occur nearer to the surface, in the 0-2 meter stratum. No clear vertical migration was observed. The epilimnion was undersaturated (< 40% oxygen) and contained < 0.1 microM phosphate, ammonium and nitrate. The hypolimnion contained substantial phosphate (> 2 microM) and ammonium (> 5 microM), but little nitrate (< 0.1 microM). A peak in particulate carbon and nitrogen occurred between 4-5 meters, just below the thermocline, and was associated with a pigment maximum. (Author's abstract)
W85-06449

FINE STRUCTURE OF THE VERTICAL DISTRIBUTION OF ORGANIC AND INORGANIC PHOSPHORUS (TONKAYA STRUKTURA VERTIKAL'NOGO RASPREDELENIYA ORGANICHESKOGO I MINERAL'NOGO FOSFORA),
V. V. Sapozhnikov, and V. L. Zubarevich.
Okeanologiya, Vol. 24, No. 5, p 772-776, November/December, 1984. 2 Fig, 7 Ref.

Descriptors: *Phosphorus, *Vertical distribution, *Lakes, Euphotic zone, Photosynthesis, Nitrates, Silicates, Minerals, Intermittent lakes, Intermittent streams.

Fine vertical structure of organic and inorganic phosphorus has been studied in the euphotic layer and in the intermittent waters. It is suggested that the maxima of organic phosphorus and oxygen at the depth of 20 meters result from the intensive development of the photosynthesis processes during the day-time which are accompanied by the assimilation of inorganic phosphorus, nitrates and silicate. In the night-time metabolic matter is accumulated in the same layer, which results in an increase of mineral and organic forms of phosphorus, nitrogen and silicate, accompanied by oxygen consumption. (Author's abstract)
W85-06457

AGGREGATES OF ORGANIC SUBSTANCES IN FRESH WATERS AND THEIR ROLE IN NUTRITION OF FILTER FEEDING CLADOCERS (AGREGATY ORGANICHESKIKH VESHCHESTV V PRESNYKH VODAKH I IKH ROL'V PITANII RACHKOV-FIL'TRATOROV),
M. A. Kuznetsova, O. V. Orlova, and A. B. Savinov.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 3-8, 1984. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Dissolved solids, *Aquatic animals, Films, Organic matter.

Dissolved organic substances (DOS) of a protein nature in fresh water can change to an aggregate state, forming films on the surfaces of air bubbles or mineral particles. After the bubble failure, the films, ranging from 3 to 48 microm thick, remain in the water strata. In the cases where the films form on the mineral particle surface, they are 35-60 microm thick. These formations occur in experiments with the initial DOS concentration of 3 mg/l amounting to 1 to 50,000 particle/l depending on the size. DOS in such a form are consumed by filter animals. Experiments with cladocers show that addition of different DOS aggregates enhances the growth rate and fecundity of cladocers. The accumulation of labelled carbon 14C in the cla-

docer body is indicative of the OS aggregate incorporation in the animal metabolism. (Author's abstract)
W85-06458

RELATION BETWEEN CERTAIN COMPONENTS OF PLANKTONIC COMMUNITY AND THE CONTENT OF PHOSPHATES AND OXYGEN IN WATER (VZAIMOSVYAZI MEZHDV NEKOTORYMI KOMPONENTAMI PLANKTONNOGO SOOBSHCHESTVA I SODERZHANIEM FOSFATOV I KISLOROBA V VODE),
Y. S. Chuikov, and A. A. Strogonov.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 9-17, 1984. 1 Fig, 3 Tab, 26 Ref.

Descriptors: *Zooplankton, *Phosphates, *Dissolved oxygen, *Volga delta, Eutrophic lakes, Population dynamics, Water pollution effects.

Correlation dependences were studied between indices of zooplankton development and the contents of phosphates and oxygen dissolved in water bodies subjected to an eutrophic effect from birds settling in the Volga delta. Estimates are given for the value and direction of relations between phosphate and oxygen concentrations in water, between these indices and zooplankton numbers and biomass as a whole, and between numbers and biomass of Rotatoria, Copepoda and Cladocera. All the studied systematic groups of planktonic invertebrates respond as a single system to environmental variations. At the same time the relation of various systematic groups of invertebrates to the investigated factors is different. Variations in the amounts of Cladocera are most closely related to changes in phosphate concentrations in water, those of Copepoda are less close. Rotatoria reveal no significant relations of concern. As to the content of oxygen dissolved in water, the systematic groups of the invertebrates are arranged in an inverse order. (Author's abstract)
W85-06459

MICROFLORA OF BOTTOM SEDIMENTS IN THE NAROCH LAKE (MIKROFLORA DONYKH OTLOZHENII OZ. NAROCH'),
G. A. Inkina, O. N. Savelieva, and O. M. Itkina.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 49-52, 1984. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Bottom sediments, *Microflora, *Naroch Lake, *Lakes, Bacteria.

Data on the quantity, biomass, and number duplication times are given for bacteriobenthos of various types in Naroch Lake. From these results the role of microorganisms in biological water self-purification and quality control may be assessed more completely. (Author's abstract)
W85-06460

PRIMARY PLANKTON PRODUCTION OF LAKE SHARTASH (PERVICHNAYA PRODUKTSIYA PLANKTONA V OZ. SHARTASH),
G. V. Bardysheva, and A. P. Vasilchikova.
Gidrobiologischeski Zhurnal, Vol. 21, No. 2, p 9-12, 1984. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Primary productivity, *Phytoplankton, *Lakes, *Lake Shartash, Productivity, Aquatic produtivity.

Information on the primary phytoplankton production is given for Lake Shartash. The findings characterize the lake as a water body of high productivity. (Author's abstract)
W85-06465

TYPOLOGICAL CHARACTERISTICS OF LATVIAN LAKES FOR INFUSORIA SPECIES COMPOSITION (TIPOLOGICHESKAYA KHARAKTERISTIKA OZER LATVII PO VIDOVOMV SOSTAVU INFUZORII),
R. A. Liepa.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 13-17, 1984. 1 Tab, 17 Ref.

Descriptors: *Zooplankton, *Species composition, *Lakes, Benthos, Oligotrophic lakes, Eutrophic lakes, Eutrophication, Trophic levels.

Studies were made of protozooplankton and benthos in two lakes which represent two different types of oligotrophic-eutrophic succession, the oligotrophic Vaidavas and the polytrophic Kiruma lakes of the Latvian SSR. The study shows that infusoria species diversity of the oligotrophic lake is higher than that of the polytrophic lake, and the quantitative development of infusoria is lower. Both lakes reveal a littoral-to-pelagial increase in trophy, with distinctions between littoral communities of protozooplankton and protozoobenthos being slightly pronounced after the polytrophic state is reached. (Author's abstract)
W85-06466

TROPHIC STRUCTURE OF BIOCENOSES IN THE TSIMLYANSKOE RESERVOIR BENTHOS (TROFICHESKAYA STRUKTURA BIOTSENOZOV BENTOSA TSIMLYANSKOGO BODKHRANILISHCHA),
M. P. Miroshnichenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 28-35, 1984. 5 Fig, 6 Tab, 22 Ref.

Descriptors: *Tsimlyanskoe Reservoir, *Trophic levels, *Fish, Benthic fauna, Aquatic animals, Reservoirs.

Pecularities in the trophic structure of biocenoses of benthos living in the Tsimlyanskoe Reservoir are reported. The findings were revealed during an analysis of the food relationships of various benthic animals. From the findings it was possible to estimate the food basis of benthophage fishes living in the reservoir. (Author's abstract)
W85-06467

METHODOLOGICAL PRINCIPLES FOR ECOLOGICAL CLASSIFICATION OF SURFACE WATER QUALITY (O METODOLOGICHESKIKH OSNOVAKH EKOLOGICHESKOI KLASSIFIKATSII KACHESTVA POVERKHNOSTNYKH VOD SUSHI),
For primary bibliographic entry see Field 5A.
W85-06473

NECESSITY OF CREATION OF UNIVERSAL WATER QUALITY CLASSIFICATION (O NEOBKHODIMOSTI SOZDANIYA UNIVERSAL'NOI KLASSIFIKATSII KACHESTVA VOD),
For primary bibliographic entry see Field 5A.
W85-06474

EVALUATION OF SAPROBIC CHARACTER OF CERTAIN SMALL RESERVOIRS OF THE UKRAINE FOR PHYTOPLANKTON (OTSENKA SAPROBNOSTI NEKOTORYKH MALYKH VOVOKHRANILISHCH UKRAINY PO RITOPLANKTONU),
For primary bibliographic entry see Field 5C.
W85-06475

ABIOTIC ENVIRONMENTAL FACTORS AND PRIMARY PRODUCTION OF WATER BODIES OF THE KOVDA RIVER BASIN (ABIOTICHESKIE FAKTORY STEDY I PERVICHNAYA PRODUKTSIYA VODOEMOV BASSEINA R. KOVDY),
N. S. Kharkevich, A. V. Sabylina, M. I. Basov, I. G. Vislyanskaya, and E. A. Klyukina.
Gidrobiologischeski Zhurnal, Vol. 20, No. 5, p 16-24, 5 Fig, 5 Tab, 9 Ref.

Descriptors: *Water chemistry, *Primary productivity, *Kovda River Basin, Phytoplankton, Biomass, Organic matter, Decomposition, Chlorophyll, Macrophytes, Aquatic plants.

The paper presents a hydrochemical characteristic of Top Lake, Pija Lake, and Kovd Lake, including data on phytoplankton biomass (its mean and maximum values for all seasons), organic matter production and destruction. A quantitative characteristic of the chlorophyll content in the lacustrine phytoplankton is given. An attempt is made to calculate the diurnal assimilation number. Phytomass of macrophytes is determined on the whole for each water body. (Author's abstract)
W85-06480

INTENSITY OF DENITRIFICATION IN THE RYBINSK RESERVOIR GROUNDS (INTENSIVNOST' DEMITRIFIKATSII V GRUNTAKH RYBINSKOGO VODOKHRANILISHCHA),
For primary bibliographic entry see Field 2J.
W85-06481

CHLOROPHYLL A IN WATER OF LAKE BAIKAL (KHLOROFILL A V VODE OZ.BAIKAL),
For primary bibliographic entry see Field 5B.
W85-06483

STUDY OF A SHALLOW CARP (CYPRINUS CARPIO L.) POND AND ITS RELEVANCE TO INLAND FISH FARMING IN LIBYAN JAMAHIRIYA,
Garyounis Univ., Benghazi (Libya). Dept. of Zoology.
For primary bibliographic entry see Field 8I.
W85-06486

CHECKLIST OF THE SPECIES OF FISHES IN LAKE MAUREPAS, LOUISIANA,
Southeastern Louisiana Univ., Hammond. Dept. of Biological Sciences.
T. Millican, D. Turner, and G. Thomas.
Louisiana Academy of Sciences, Vol. 47, p 30-33, December, 1984. 3 Ref. NOAA grant NA-83-AAA-D-CZ025.

Descriptors: *Population dynamics, *Fish, *Lake Maurepas, *Louisiana, Estuarine environment, Lakes, Data collection.

Lake Maurepas, a large Louisiana estuarine lake located west of Lake Pontchartrain, encompasses a surface area of 5800 acres with a mean depth of 2.53 m. Preliminary sampling in the fall through spring of 1983 to 1984 of Lake Maurepas yielded a catch of 22 families, 29 genera, and 39 species of fish. Gillnets and trawls were used as the main types of collecting gear. The majority of fishes collected, 24 species, are considered freshwater residents, and 15 species are euryhaline or marine transients. Comparison of these results with prior investigations are inconclusive due to variations in gear type, seasons, length of study, and because they combined samples obtained from Lake Pontchartrain and Maurepas. (Baker-IVI)
W85-06488

LATERAL SOLUTE CONCENTRATION GRADIENTS IN STRATIFIED EUTROPHIC LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Water Resources Research, Vol. 21, No. 4, p 554-562, April, 1985. 6 Fig, 5 Tab, 29 Ref. EPA Research grant R805-281.

Descriptors: *Eutrophic lakes, *Dissolved oxygen, *Phosphorus, *Lake Mendota, *Green Lake, *Wisconsin, Lake sediments, Eddy diffusion, Metalimnion, Hypolimnion, Shelf sediments, Solute transport.

Lateral concentration gradients in dissolved oxygen and phosphorus were studied in the metalimnion of Lake Mendota and the hypolimnion of Green Lake, Wisconsin. Oxygen concentrations were invariably lower (by up to 4.5 mg/L) in the 3-m interval overlying shelf sediments as compared to adjacent stations in deeper water. Conversely, phosphorus concentrations were up to 65 mg/cu m higher overlying the shelves. In Mendota, the 'shelf shift' - Delta O/Delta P, was low as compared to expectations based on Redfield's equation for the aerobic oxidation of sedimenting phytoplankton; this difference indicates a net sediment release of P under aerobic conditions, corroborating laboratory studies. For Lake Mendota a phos-

phorus profile at the deep hole station underestimates total lake phosphorus by cira 3% in midsummer. Because of its elongated asymmetric basin and related factors, the deep hole sampling bias is larger (cira 15%) for Green Lake. Based on lateral oxygen gradients and flux-gradient computations, the lateral eddy diffusivity is 200,000 sq m/day in the metalimnion of Mendota and the hypolimnion of Green Lake. (Author's abstract)
W85-06509

WAVE DISTURBANCE ON LAKESHORES AND THE WITHIN-LAKE DISTRIBUTION OF ONTARIO'S ATLANTIC COASTAL PLAIN FLORA,
Ottawa Univ. (Ontario). Dept. of Biology.
P. A. Keddy.
Canadian Journal of Botany, Vol. 63, No. 3, p 656-660, March, 1985. 3 Fig, 1 Tab, 29 Ref.

Descriptors: *Wave action, *Lake shores, *Plants, *Ecological distribution, *Axe Lake, *Ontario, Substrates, Water level fluctuations, Shores, Nutrients, Particle size.

Although water level fluctuations may explain the persistence of Atlantic coastal plain species in certain Georgian Bay lakes, they cannot explain the within-lake distribution of this flora. To test whether the within-lake distribution of these species was correlated with disturbance from waves, 25 transects were quantitatively sampled along an exposure gradient in Axe Lake, Ontario. The proportion of Atlantic coastal plain species in a transect increased significantly with exposure ($p < 0.01$). Total frequency of Atlantic coastal plain species reached a maximum at an intermediate level of exposure. Analysis of substrate samples showed that the exposure gradient is a multivariate gradient including not only biomass removal by waves, but sorting of the shoreline substrate. The coarse, nutrient poor sites on exposed shore may allow the persistence of Atlantic coastal plain species in at least two different ways. Their physiological tolerance limits may be narrowly specialized on exposed shorelines. Alternatively, their physiological tolerances may include a broad range of shoreline types, but competition restricts them to those sites least suitable for other species. (Author's abstract)
W85-06518

ELEMENT ACCUMULATION AND RELEASE BY MACROPHYTES IN A WETLAND STREAM,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
J. H. Peverly.
Journal of Environmental Quality, Vol. 14. No. 1, p 137-143, January/March, 1985. 2 Fig, 4 Tab, 32 Ref. OWRT grant A-079-NY.

Descriptors: *Macrophytes, *Streams, *Wetlands, Oak Orchard Creek, New York, Plant growth, Nitrogen, Phosphorus, Potassium, Aquatic plants, Nutrients, Stream sediments.

Aquatic macrophyte growth and element accumulation was measured seasonally for 1 yr in Oak Orchard Creek, NY, and compared with stream element loads. The stream flows from drained and cultivated wetland soils upstream into undisturbed wetlands downstream. The stream was calcareous and near saturation with CO2 most of the time. It was enriched with dissolved N, P, and K in both water and sediments, especially just below the cultivated area. Plant biomass was greatest at the lower end of the wetlands in July, ranging up to about 600 g dry wt/sq m and consisting mostly of elodea (Elodea canadensis Michx.) and curlyleaf pondweed (Potamogeton crispus L.). Maximum net biomass accumulation rate was about 0.06 mg C/sq m/s for sago pondweed (Potamogeton pectinatis L.). Element concentrations in plant tissues were above limiting levels and showed no definite relationship to season or species, although instream emergent plants showed a fall decrease in major nutrients (N, P, and K). Tissue nutrient concentrations were related to position in stream, increasing as the nutrient concentrations increased in the water. Maximum nutrient load contained by the plants occurred in July, which corresponded to the maximum standing crop. Potential contributions of major nutrients to the creek from plant senescence that occurred instream ranged from 10 to 100% in summer and fall. However, this contribution is 1 to 2% of total annual stream nutrient load. (Author's abstract)
W85-06625

CHEMICAL COMPOSITION OF AQUATIC VEGETATION IN SOME TYPICAL WETLANDS OF KASHMIR,
Himachal Pradesh Univ., Simla (India). Dept. of Biosciences.
S. Kaul.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 47-57, 1983. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Aquatic plants, *Wetlands, *Chemical composition, *Kashmir, *India, Calcium, Magnesium, Sodium, Potassium, Phosphorus, Nitrogen, Macrophytes, Litter.

The mineral content in macrophyte below-ground biomass, above-ground biomass and litter was investigated in five wetlands in the valley of the river Jehlum, in Kashmir, India. The concentrations of calcium, magnesium, sodium, potassium, phosphorus and nitrogen in the dry matter were determined in March, May, July, September, November, and January. Na, P, K and Ca showed decreasing concentrations from spring to autumn. Na and Mg concentrations showed an irregular trend. On the whole, the incorporated mass of substances per unit of area increases in the course of the period of vegetation for the below-ground biomass as well as the above-ground biomass. In general, significant variations were observed with regard to both time and site differences in mineral constituents; P and K of litter were the only exceptions, where significant variations with respect to time were not observed. Ca and N did not show any significant variation with regard to site. The mineral content in litter is comparatively lower than in the fresh biomass. This can be attributed to the invasion of the dead tissues by bacteria and fungi, and the leaching out of the nutrients from withering tissues. (Moore-IVI)
W85-06651

OXYGEN CONCENTRATION OF WATERS OF THE FELDBERGER LAKE DISTRICT ON THE BASIS OF SELECTED SUMMER DEPTH PROFILES FROM 1924 THROUGH 1962. PART 2: ZANSEN, WOOTZEN, CARWITZER LAKE, DREETZ AND KRUSELIN (ZUM SAUERSTOFFHAUSHALT DER GEWASSER DER FELDBERGER SEENPLATTE AN HAND AUSGEWAHLTER SOMMERLICHER TIEFENPROFILE SEI 1924 BZW. 1962. TEIL 2: ZANSEN, WOOTZEN, CARWITZER SEE, DREETZ UND KRUSELIN),
Bonito A.G., Osterburg (German D.R.).
W. M. Richter.
Acta Hydrochimica et Hydrobiologies, Vol. 11, No. 1, p 59-73, 1983. 5 Fig, 2 Tab, 35 Ref.

Descriptors: *Dissolved oxygen, *Depth profiles, *Zansen, *Wootzen, *Carwitzer, *Dreetz, *Kruselin, *Germany (Federal Republic), Metalimnion, Transparency, Water temperature, Hydrogen sulfide, Eutrophication, Water quality, Hydrography.

For the four lakes of the lower Feldberg lake district as well as for the Kruselin, situated on the periphery of the lake district, summer depth profiles of the oxygen concentration together with the metalimnion, transparency, water temperature and the depth limit of the occurrence of hydrogen sulfide are represented for the period from 1924 or 1962 to 1980. The profiles very clearly demonstrate the progressive eutrophication of these lakes, but also the beginning of improvement of the quality of their water. Important data on hydrography as well as the possibilities of restoration are discussed. (Author's abstract)
W85-06652

SEDIMENTATION AND SEDIMENT ANALYSIS IN MUGGEL LAKE (SEDIMENTATION UND SEDIMENTANALYTIK IM MUGGELSEE),
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
G. Mothes.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 75-99, 1983. 14 Fig, 1 Tab, 25 Ref.

Descriptors: *Sedimentation, *Sediments, *Muggel Lake, *German Democratic Republic, Carbon, Nitrogen, Phosphorus, Primary productivity, History, Lake restoration.

Organically bonded carbon which sediments during the period of vegetation growth in Muggel lake amounts to 10% of the carbon quantity which is bonded by primary production during that time period. The lake is one of the water supply sources for the capital of the German Democratic Republic. The sedimentation behavior is discussed, as is the composition of sediments with regard to their content of combined carbon, nitrogen and phosphorus and other substances. Conclusions are presented concerning the history of Muggel Lake for past centuries and the possibility of restoring it. (Author's abstract)
W85-06653

ROLE OF THE LITTORAL (SHALLOW) ZONE IN RESERVOIR PRODUCTIVITY,
Central Inland Fisheries Research Inst., Mirzapur (India). Sub-Center Rihand Dam.
P. K. Smith.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 101-107, 1983. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Reservoirs, *Rihand Reservoir, *India, *Littoral environment, *Productivity, Transparency, Calcium, Magnesium, Physicochemical properties, Seasonal variation, Dissolved oxygen, Silicates, Bicarbonates, Carbon dioxide.

The Rihand reservoir (India) which is used for hydroelectricity generation has a surface area of 46,588 ha, a capacity of 10.6 cu km, and a shore line length of 561 km. Most of the elements dissolved in water were found at higher levels in the littoral zone than in the profundal zone. The higher concentration of dissolved oxygen in the littoral zone was mostly due to a high rate of photosynthesis and mixing. The low values of free carbon dioxide in the littoral zone are mainly due to its high consumption during photosynthesis as this zone was richer in phytoplankton. The high values of bicarbonate and the low values of carbon dioxide in the littoral zone indicated the conversion of carbon dioxide into bicarbonate with the association of hydroxyl ion. The consumption of nitrate and phosphorus by densely growing plankton crop was higher in the littoral zone than in the profundal zone. High values of calcium and magnesium ions and hardness in the littoral zone showed the greater release or calcium and magnesium ions from soil due to cation exchange and organic matter decomposition. Dissolved organic matter, silicate and iron followed the same trend as the other nutrients. The net and gross productions, mainly controlled by the plankton population, penetration of light and transparency were high in the littoral zone and low in the profundal zone, due to the variable conditions in the littoral zone. (Baker-IVI)
W85-06654

DO-PROCESS MODELS FOR SHALLOW SYSTEMS. PART 1: PONDS AND LAKES,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 2K.
W85-06655

PRODELTA ENVIRONMENT OF A FJORD: SUSPENDED PARTICLE DYNAMICS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Centre.
J. P. M. Syvitski, K. W. Asprey, D. A. Clattenburg, and G. D. Hodge.
Sedimentology, Vol. 32, No. 1, p 83-107, February, 1985. 27 Fig, 4 Tab, 48 Ref.

Descriptors: *Fjords, *Butte Inlet, *British Columbia, *Prodelta environment, *Suspended solids, Deltas, Sedimentation.

Sediment-flux calculations for the prodelta environment are imprecise because of the sampling problem in relating sediment dynamics to variable flow conditions. This problem is less severe in fjords since the flow is confined by the walls. The dynamics of suspended particle within Butte Inlet, British Columbia, were investigated and the results compared with larger non-enclosed prodelta environments. In the upper prodelta, the seaward-flowing river plume flows over the ambient marine water depositing much of the initial riverine suspended load. Particles less than 10 micro m have similar settling velocities regardless of size because they settle in flocs: the settling velocity at a water depth of 5 m is 30 m/day and increases with depth so that at 30 m the particles settle at 100 m/day. For larger particles, the downward settling velocity enhancement due to flocculation decreases with increasing grain size. Particle dynamics in the lower prodelta are dependent on the character of the freshwater wedge that thins seaward of the upper prodelta. The vertical flux of particles is controlled by biogeochemical interactions such as pelletization of fine particles and flocculation which occurs within the surface layer. The pellets are produced by indiscriminate filter feeding zooplankton. Across the lower prodelta the suspensate character, recognized in the composition of both flocs and pellets, changes from a dominance of mineral grains to that of autochthonous organic matter. The interaction of bacteria with the suspended particles increases with depth and seaward distance. At depth, the mucoid filaments form stable interconnecting webs. Particle concentration in the surface layer decreases at rates proportional to the distance seaward but differently for the upper and lower prodelta. (Collier-IVI)
W85-06698

SEASONAL SUCCESSION AND MICROLAMINA FORMATION IN A MEROMICTIC LAKE DISPLAYING VARVED SEDIMENTS,
Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2J.
W85-06699

DISSOLVED SILICON IN A NORTH WALES CATCHMENT OF HIGH RELIEF,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
For primary bibliographic entry see Field 2K.
W85-06728

EFFECT OF STORMS ON NITRIFICATION RATES IN A SMALL STREAM,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 2K.
W85-06730

VEGETATION OF THREE MOUNTAIN MIRES, WEST TAUPO, NEW ZEALAND,
New Zealand Forest Service, Rotorua. Forest Research Inst.
B. R. Clarkson.
New Zealand Journal of Botany, Vol. 22, No. 3, p 361-375, 1984. 9 Fig, 2 Tab, 18 Ref, 3 Append.

Descriptors: *Vegetation, *Mires, *Taupo, *New Zealand, Wetlands, Drainage, Ferns, Sedges, Shrubs, Mosses, Trophic level, Pumice.

Vegetation is described at three mountain mires (informally named Ongarue A, B, and C) in the proposed Pureora Mountain Ecological Area, west Taupo, on the North Island of New Zealand. Data were collected from systematically-located plots, using a modified Braun-Blaunquet cover scale. Ordination techniques arranged the plots and species in a sequence from sedge-fernland through shrubland to forest, following a gradient of increasingly better drainage. Plot classification identified four mappable floristic groups which reflect drainage conditions and mire nutrient status. The central part of the mires comprises a mosaic of low vegetation types in which the dominant plant is the fern Gleichenia dicarpa. Sedges (Lepidosperma australe, Carpha alphina, Baumea rubiginosa), mosses (spagnum, Dicranoloma robustum), and a few low shrubs (monoao, manuka) vary in prominence with different drainage conditions. Ongarue A mire is predominantly oligotrophic according to Dobson's diagram of the relationship between mean temperature and overall fertility; local mesotrophic conditions, as a result of increased waterflow, are reflected by the presence of B. rubiginosa and, to a lesser extent, sphagnum. The smaller Ongarue B and C mires are mainly mesotrophic, with minor oligotrophic patches. Deposition of Taupo pumice may have caused a deterioration of drainage in Ongarue A mire, which may account for an apparent change in vegetation from a shrub mire to the present predominantly herbaceous mire. If no future disturbance(s) occurs, the Ongarue mires, particularly Ongarue A mire, can be expected to become increasingly oligotrophic. (Rochester-IVI)
W85-06785

FRESHWATER WETLAND VEGETATION OF VITI LEVU, FIJI,
University of the South Pacific, Suva (Fiji). School of Natural Resources.
J. Ash, and W. Ash.
New Zealand Journal of Botany, Vol. 22, No. 3, p 377-391, 1984. 9 Fig, 1 Tab, 16 Ref.

Descriptors: *Wetlands, *Vegetation establishment, *Viti Levu, *Fiji, *Pacific Islands, Bogs, Soil properties, Soil types, Drainage, Peat bogs, Land use.

Viti Levu is the largest island of the archipelago of the Fiji Islands. The island's wetlands are a prominent feature of the densely populated coastal areas of the high rainfall regions of the island and occur on Recent alluvium. Most of the wetlands formed after the sea reached its present level, and they have probably been affected by man through most of this time. The peat bogs developed as a result of forest clearance in areas of impeded drainage. The wetlands are classified into peat, colluvium-peat, gley soils, and brackish soils, and the vegetation is described for each of the major wetlands and substrate types. Most of the native wetland plant species also occur in dryland habitats. The majority of the plant species are recent introductions. The coastal wetlands are all formed in association with, and overlie, coastal landforms which have formed since the sea reached its present level 6000-3000 years ago. It is probable that man has been in Viti Levu for most if not the entire history of the present lowland freshwater wetlands; most of the lowland wet gley soils were cultivated up to the margins of the peat swamps. The natural vegetation of the freshwater gley soils is forest. The present vegetation represents the outcome of human disturbance. Areas which are cleared of trees are rapidly colonized by sedges, grasses, and herbs; if these herbaceous assemblages are not burned or grazed then shrubs and trees are soon established, and a tree assemblage eventually results. The combination of forest clearance, occasional cultivation and burning is probably sufficient to create peat bogs in areas of naturally impeded drainage. The dispersal of Sphagnum cuspidatum, Metroxylon vitiense, and Eleocharis dulcis is discussed. (Collier-IVI)
W85-06786

PREDICTING CONCENTRATION OF TOTAL PHOSPHORUS AND CHLOROPHYLL A IN A LAKE WITH SHORT HYDRAULIC RESIDENCE TIME,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
B. J. Premo, C. D. McNabb, F. C. Payne, T. R. Batterson, and J. R. Craig.
Hydrobiologia, Vol. 122, No. 3, p 231-241, March, 1985. 1 Fig, 6 Tab, 33 Ref.

Descriptors: *Phosphorus, *Chlorophyll a, *Residence time, *Skinner Lake, *Indiana, *Lakes, Nutrients, Nitrogen, Seasonal variation, Algae, Hydrology.

The relationship between total phosphorus and chlorophyll a concentration was determined for Skinner Lake, Indiana over an annual cycle in 1978-79. Total nitrogen:total phosphorus ratios in the epilimnion ranged from 19 to 220 suggesting a phosphorus-dependent algal yield in the epilimnion. Approximately 90% of annual TP loading reached the lake via streamflow, and 93% of this entered during snowmelt and spring-overturn periods. At that time incoming water flushed the lake 2.4 times. Atmospheric loading accounted for 1.4% of annual TP load. Internal hypolimnetic TP loading occurred during summer stratification. Mean concentration of chl a for the ice-free period was 15.15 mg/cu m, within the range expected for eutrophic lakes. The 1978-79 data were used in conjunction with the Vollenweider and Kerekes model to produce a model specific for the Skinner Lake system. The model predicted mean epilimnetic total phosphorus and chlorophyll a concentrations from mean total phosphorus concentration in inlet streams and from lake water residence time during the period of spring overturn and summer stratification. The Skinner-specific model was tested in 1982 and it closely predicted observed mean epilimnetic TP and chl a concentrations during the ice-free period. Variability in lake models which average data over an annual period can be reduced by considering lake-specific seasonal variation in hydrology and external TP loading. (Author's abstract)
W85-06789

QUANTITY AND QUALITY OF SESTON IN AN IMPOUNDED AND A FREE-FLOWING RIVER IN VIRGINIA, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Entomology.
J. R. Voshell, Jr., and C. R. Parker.
Hydrobiologia, Vol. 122, No. 3, p 271-280, March, 1985. 3 Fig, 5 Tab, 42 Ref.

Descriptors: *Seston, *Reservoirs, *Virginia, *North Anna River, *South Anna River, *Ecological effects, Particle size, Rivers, Resources development, Zooplankton, Diatoms, Algae.

Seston in the impounded North Anna River (NAR) was analyzed and compared to that in the free-flowing South Anna River (SAR) in Virginia, U.S.A. A wet filtration technique was used to separate seston into five size classes. The overall quantity of organic seston was much lower in the NAR than in the SAR. The seston in the NAR was composed of more living organisms, in particular zooplankters in the medium large (234-864 micro m) and small (105-234 micro m) size classes and diatoms and other algae in the fine (43-105 micro m) and very fine (25-43 micro m) size classes. The percentage of zooplankton declined sharply before reaching the downstream study site (32 km). The seston in the NAR tended to consist of slightly larger particles, but 80-85% of the seston in both rivers was in the ultrafine (0.45-25 micro m) size classes, which was almost entirely composed of detritus. One indication of seston food quality, the organic/inorganic ratio, was considerably higher for the medium large and small size classes in the NAR immediately below the dam and for the fine and very fine size classes farther downstream. Another indication of food quality, the usable caloric content, showed that the seston in the NAR contained considerably less total assimilable energy as far as 32 km downstream from the dam, but that the medium large and small size classes were rich in assimilable energy immediately below the dam because of zooplankton released from the reservoir. Thus, the overall quantity and quality of seston was lower in the NAR, but the quality of the seston, for at least a short distance below the dam, was higher in a well-defined size range that can be effectively utilized by certain filter feeders. (Author's abstract)
W85-06791

BENTHIC COMMUNITY METABOLISM IN FOUR TEMPERATE STREAM SYSTEMS: AN INTER-BIOME COMPARISON AND EVALUATION OF THE RIVER CONTINUUM CONCEPT,
Academy of Natural Sciences of Philadelphia,

Avondale, PA. Stroud Water Research Center.
T. L. Bott, J. T. Brock, C. S. Dunn, R. J. Naiman, and R. W. Ovink.
Hydrobiologia, Vol. 123, No. 1, p 3-45, April, 1985. 13 Fig, 16 Ref, 95 Ref. NSF grants BMS-7507333 and DEB-78-11671.

Descriptors: *Metabolism, *Benthos, *River continuum concept, *Pennsylvania, *Michigan, *Idaho, *Oregon, *Biomes, Ecology, Photosynthesis, Primary productivity, Respiration, Photosynthetically active radiation, Water temperature, Chlorophyll a, Productivity.

Benthic community metabolism was studied on four stream systems located in different biomes in the United States: the eastern deciduous forest (Pennsylvania, PA, and Michigan, MI), the high desert (Idaho, ID), and the coniferous forest (Oregon, OR). Studies were designed to test the hypothesis advanced within the River Continuum Concept that a transition in community metabolism will occur from a predominance of heterotrophy in headwaters to a predominance of autotrophy in mid-sized reaches, with a return to heterotrophy further downstream. Both gross primary productivity (GPP) and community respiration (CR sub 24) increased with downstream direction on all systems. Net daily metabolism (NDM, or GPP CR sub 24) shifted from heterotrophy (NDM, GPP < CR sub 24) to (+NDM, GPP > CR sub 24) with downstream direction at all sites, supported the hypothesis. Annual metabolism in the most upstream reach all sites was dominated by respiration; however, the farthest downstream reach was not necessarily the most autotrophic. Site-specific factors affected manifestation of the trend. Photosynthesis predominated annual metabolism in reaches (designated 1-4 in order of increasing size) 2-4 in ID, 3 and 4 in OR, and 4 in MI. In PA annual photosynthesis was slightly greater than respiration only at Station 3. Photosynthesis was predominant most consistently in ID and respiration most often in PA. About half the reaches that were heterotrophic annually were autotrophic at one or more seasons. Annual means of benthic GPP, CR sub 24 and NDM ranged from 0.16 to 3.37, 0.36 to 2.88 and 0.73 to 0.50 g O2/sq m/d, respectively. Metabolic rates were usually high in PA and MI (and sometimes ID) and almost always lowest in OR. Parameters accounting for most variance in multiple linear regression analyses of the combined metabolism data from all sites were indicators of stream size, photosynthetically active radiation, temperature, and chlorophyll a concentration. (Author's abstract)
W85-06792

PRIMARY PRODUCTIVITY AND SPATIAL STRUCTURE OF PHYTOLITHIC GROWTH IN STREAMS IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK, TENNESSEE,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
E. D. Keithan, and R. L. Lowe.
Hydrobiologia, Vol. 123, No. 1, p 59-67, April, 1985. 4 Fig, 3 Tab, 31 Ref.

Descriptors: *Primary productivity, *Benthos, *Algae, *Great Smoky Mountains National Park, *Tennessee, *Rocks, Logging, Ecological effects, Diatoms, Chlorophyll a, Species composition, Diversity, Productivity.

The primary production rates of phytolithic communities found in the major different habitats of streams were studied and the effects of physical and chemical parameters associated with each habitat on periphyton community spatial structure were determined. The project was designed to study natural, intact communities within stream systems. A comparative analysis was made of phytolithic communities found in Camel Hump and Husky Branch streams in the Great Smoky Mountains National Park. Camel Hump flows through virgin forest area and Husky Branch flows through an area logged approximately 60 y ago. The effects of logging on Husky Branch stream and the surrounding watershed are discussed. Seasonal data were collected from July, 1981 through May, 1982 from fast flow, slow flow and pool areas within each stream. An incubation chamber designed for use in lotic systems was used for in situ measurements of 14 C uptake. Rock samples collected at each site were used as substrates for community structure observations utilizing a scanning electron microscope. The algal communities of Camel Hump and Husky Branch streams were found to be predominantly composed of diatoms. The dominant genera in the fast, slow and pool areas included Achnanthes, Eunotia, Meridion, Navicula and Gomphonema. Fast flow areas were dominated by diatom species growing in a prostrate position. Slow flow areas were more densely populated by diatoms than the fast flow areas. Diatoms in the slow flow areas appeared mainly in prostrate position with a few stalked forms present. Pool area communities were less densely packed than slow flow areas and contained stalked and chain formations of diatoms. Results indicate that the physical and chemical parameters associated with each habitat affect the primary production rates and community structure found at the experimental sites. Measurements of carbon assimilation and chlorophyll a concentration were significantly greater in habitats of higher current velocity and light availability. Cell densities tend to increase with a decrease in current velocity. Habitats of high density showed a decrease in diversity and evenness. Correlations between productivity in the various habitats of each stream and other parameters measured in the study are discussed. (Author's abstract)
W85-06793

ACCELERATED EUTROPHICATION IN A NEW ZEALAND LAKE: LAKE ROTOITI, CENTRAL NORTH ISLAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
W. F. Vincent, M. M. Gibbs, and S. J. Dryden.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 4, p 431-440, 1984. 5 Fig, 6 Tab, 24 Ref.

Descriptors: *Eutrophication, *New Zealand, *Lake Rotoiti, *Algae, Eutrophic lakes, Cyanophyta, Phytoplankton, Hypolimnion, Oxygen demand, Trophic status.

Lake Rotoiti, North Island, New Zealand, is a deep (maximum depth, 126 m) lake surrounded by a mostly forested and farmland catchment. However, it currently demonstrates several attributes characteristic of enriched waters. Algal production is high relative to other deep basin lakes of the central North Island. The hypolimnion deoxygenates completely each year, and a bloomforming species of blue-green algae is numerically important in the summer phytoplankton. These features appear to be recent rather than longstanding properties of the Lake Rotoiti ecosystem. A detailed comparison of limnological measurements from 1955 onwards reveals a consistent decline in water clarity, a large and possibly exponential increase in hypolimnetic oxygen demand, and a conspicuous shift in the summer phytoplankton community towards blue-green algal dominance. This recently accelerated change in the trophic status of Lake Rotoiti is probably a response to the Ohau Channel inflow from Lake Rotorua. (Author's abstract)
W85-06794

NITRATE LOSS AND TRANSFORMATION IN 2 VEGETATED HEADWATER STREAMS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
A. B. Cooper, and J. G. Cooke.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 4, p 441-450, 1984. 2 Fig, 6 Tab, 31 Ref.

Descriptors: *Nitrates, *Cycling nutrients, *Eutrophication, *New Zealand, *Streams, Nutrients, Aquatic plants, Grass, Aquatic life, Nitrogen, Denitrification, Nitrogen removal.

The processes of nitrate removal from the stream waters of 2 headwater catchments were studied. In study stretches where the stream channels were vegetated with thick mats of grass (Glyceria fluitans), nitrate removal processes were particularly active. In such grassed stream channels, c. 75% of the nitrate removal was attributable to plant uptake and the remainder to denitrification. Both of these nitrate removal processes were linearly dependent on nitrate concentration, resulting in an exponential decline of nitrate level from the springs along the stream's length. Regeneration of nitrogen, by plant decay within the stream channel, results in export of dissolved organic nitrogen and particulate nitrogen from the catchments. The overall impact of vegetated stream channels in modifying nitrogen exports from catchment is discussed. (Author's abstract)
W85-06795

OPTICAL CHARACTERISATION OF NATURAL WATERS BY PAR MEASUREMENT UNDER CHANGEABLE LIGHT CONDITIONS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. J. Davies-Colley, W. N. Vant, and G. J. Latimer.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 4, p 455-460, 1984. 4 Fig, 9 Ref.

Descriptors: *Photosynthetically active radiation, *Solar radiation, *Euphotic zone, *Optical properties, Transparency, Physical properties, Light intensity, Measuring instruments.

Water bodies can be characterized optically by the euphotic depth, Z sub eu (1% of surface light), the diffuse attenuation coefficients, K sub d for downwelling light and K sub u for upwelling light, and the reflectance coefficient, R (ratio of upwelling to downwelling light), all in terms of photosynthetically active radiation (PAR). The estimation of all of these quantities from underwater PAR measurements is simple in principle but very difficult in practice under changing ambient light conditions caused by drifting cloud patches. A method of PAR measurement using a two-channel instrument which records the ratio of the response of 2 PAR sensors and thus overcomes the problems of changeable ambient light is described. Relative PAR Q(z)/Q sub r, where Q(z) is PAR (either upwelling or downwelling) at depth z, and Q sub r is reference (downwelling) PAR, is much less dependent on ambient light when the reference sensor is located in water than when located in air (deck sensor). The profiles of relative PAR can be used to calculate Z sub eu, K sub d, and K sub u. R can be measured directly as the ratio of upwelling to downwelling PAR. (Author's abstract)
W85-06797

BENTHIC MACROINVERTEBRATES OF CANE CREEK, NORTH CAROLINA, AND COMPARISONS WITH OTHER SOUTHEASTERN STREAMS,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
D. R. Lenat.
Brimleyana, No. 9, p 53-68, June, 1983. 1 Fig, 5 Tab, 20 Ref.

Descriptors: *Invertebrates, *Benthic fauna, *Cane Creek, *North Carolina, Streams, Aquatic insects, Monitoring, Ecosystems, Distribution, Environmental quality.

Data on benthic macroinvertebrates collected by several investigators working in Cane Creek, in the Piedmont Plateau of North Carolina, were combined to generate a species list of 272 taxa. This data set may define the characteristics of the 'normal' stream community in this area, and thus represent a source of control information for biological monitoring studies. Cane Creek is a third-order stream located in Orange County; it has a total drainage area of 90 sq km and average discharge of roughly 0.7 cu m/sec. Taxa from first-order tributaries differed markedly from those collected at stations farther downstream. Groups with many taxa were Ephemeroptera (30), Odonata (22), Trichoptera (31), and Diptera (80). Comparison of average taxa richness at Cane Creek (55.1 in 3 collections) with that of other North Carolina Piedmont streams (range: 43.33-55.8 in 3 or 4 col-

lections) showed considerable constancy among streams. There was often constancy within groups (eg, 8.0-9.4 for Ephemeroptera in six streams). Average taxa richness for 7 coastal Plain streams (48.4), 6 Piedmont streams (48.9), and 9 mountain streams (44.5) also appeared relatively constant. In contrast, density by organism group (as a percent of total density) for Cane Creek and five other Piedmont streams exhibited much more between-stream variability than did average taxa richness. The patterns observed suggest a constant number of niches in stream ecosystems, and indicate that average taxa richness appears to be the best tool for environmental assessment work. (Rochester-IVI)
W85-06799

SUBMERSED MACROPHYTE COMMUNITIES OF ADIRONDACK LAKES (NEW YORK, U.S.A.) OF VARYING DEGREES OF ACIDITY,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
D. A. Roberts, R. Singer, and C. W. Boylen.
Aquatic Botany, Vol. 21, No. 3, p 219-235, March, 1985. 4 Fig, 4 Tab, 34 Ref.

Descriptors: *Macrophytes, *Aquatic plants, *Adirondacks, *New York, *Lakes, *Acid lakes, Hydrogen ion concentration, Mountain lakes, Oligotrophic lakes, Water pollution effects, Species composition, Acidic water, Acidity, Sphagnum, Bulrushes, Utricularia, Pondweed.

The submersed macrophyte communities of nine high-altitude oligotrophic lakes in Adirondack Mountain region of upstate New York were characterized in detail in terms of percent cover of each species. The pH of these clear-water lakes ranges from 6.9 to 4.4 and the acid neutralizing capacity ranged from 91 micro eq/l to -38 micro eq/l. The degree of acidity covaried with lower total ion content and nutrient status. The dominant species in the circumneutral lakes and in the acidic lakes were the same, with several Utricularia species being the major component of the bottom cover. Species richness and diversity were lower in the acidic lakes (pH < 5.5). The plants found in the acidic lakes were typical of oligotrophic systems in general, regardless of pH, and similar to those found in lake surveys in Scandinavia and Eastern Canada. Potamogeton confervoides Reichenb., Scirpus subterminalis Torr., Sphagnum spp. and Utricularia geminiscapa Benj. were the only species that were primarily exclusive to the acidic lakes surveyed. In contrast to the results of Scandinavian studies, Sphagnum was found to be a major component of the plant cover in only two of the five acidic lakes. (Author's abstract)
W85-06804

APPLICATION OF LANDSAT SATELLITE DATA FOR MAPPING AQUATIC AREAS IN NORTH-EASTERN FINLAND,
Oulu Univ. (Finland). Dept. of Astronomy.
For primary bibliographic entry see Field 7B.
W85-06805

STATUS OF COLONIAL WATERBIRDS NESTING IN SOUTHERN MANITOBA,
Manitoba Dept. of Natural Resources, Winnipeg.
W. H. Koonz, and P. W. Rakowski.
Canadian Field-Naturalist, Vol. 99, No. 1, p 19-29, January-March, 1985. 38 Ref, 2 Append.

Descriptors: *Water birds, *Manitoba, *Birds, *Animal populations, Species distribution, Population density, Environmental protection, Resource management, Pelicans, Cormorants, Gulls, Grebes, Terns, Environmental impact.

The southern Manitoba nesting abundance, colony location, historic and present regional and provincial status of 12 colonial nesting waterbird species have been assembled, with major field data collected in 1979. American White Pelican (Pelecanus erythrorhynchos), Double-crested Cormorant (Phalacrorax auritus), and Ring-billed Gull (Larus delawarensis) breeding populations were at or near historic peaks with cormorant and pelican numbers larger than recent estimates for all of Canada. Eared Grebe (Podiceps nigricollis), and Western Grebe (Aechmophorus occidentalis) populations were considered in decline as were Common Tern (Sterna hirundo) and Caspian Tern (Sterna caspia) numbers. Management should include stronger protective measures, public education, colony habitat management, and monitoring of known and suspected colony locations. Human encroachment, pesticides, marsh draining, water-level manipulation, and disturbance are major threats to all Manitoba waterbird species. (Author's abstract)
W85-06844

ECOLOGY OF FRESHWATER GASTROPODS ON THE SOUTHWESTERN EDGE OF THE PRECAMBRIAN SHIELD,
Winnipeg Univ. (Manitoba). Dept. of Biology.
E. Pip.
Canadian Field Naturalist, Vol. 99, No. 1, p 76-85, January/March, 1985. 2 Fig, 3 Tab, 25 Ref.

Descriptors: *Gastropods, *Mollusks, *Precambrian Shield, *Ecological effects, Lakes, Ponds, Streams, Rivers, Oligotrophic lakes, Species diversity, Water chemistry, Hydrogen ion concentration, Alkalinity, Dissolved solids, Nitrates, Nitrites, Phosphates, Chlorides, Sulfates, Organic matter, Oligotrophy, Dystrophy, Dystrophic lakes.

The Canadian Shield region provides an abundance of oligotrophic and dystrophic habitats. A study was made of the apparent tolerance ranges of gastropods with respect to pH, total alkalinity, total dissolved solids, total nitrate and nitrite, molybdenum reactive phosphorus, chloride, sulfate, and dissolved organic matter at 100 stations on the southwestern edge of the Precambrian Shield. Snail and aquatic plant community diversity, and interspecific associations among gastropods as well as among plants and gastropods were also examined. A total of 40% of the sites were lakes (>10 ha), 24% were ponds (<10 ha), 24% rivers (>2 m deep) and 12% creeks (<2 m deep). Of the 31 gastropod species found in the area, 15 were recorded at 5 or more sites, and of these, Gyraulus deflectus occurred in the most diverse snail and aquatic plant communities; Stagnicola elodes frequented communities with low diversity. Helisoma campanulatum showed the greatest tendency to occur in waters with low total dissolved solids, while S. elodes appeared to be poorly adapted to the soft waters of the region. Chi-square analysis of interspecific gastropod associations adjusted for apparent tolerance ranges yielded a single planar cluster composed of 13 species interrelated by 18 positive associations. Chi-square tests also identified 49 positive snail-plant associations, 11 of which involved H. campanulatum. Ponds showed the lowest snail and plant diversity; these sites also often showed the most extreme water chemistry values. The ecology of freshwater gastropods may show regional variation, since some species appear to undergo a certain amount of adaptation to the environmental characteristics prevailing in the Shield sites. The gastropods typical of Shield waters form a tightly-knit association cluster which reflects to some degree the qualities of the habitats where the species tend to occur. The gastropods also form numerous associations with Shield macrophytes; in some cases these appear to be the result of similar ecological affinities. (Collier-IVI)
W85-06846

TWENTY-FIVE YEARS OF PHYTOPLANKTON ON THE WEST FORK AND MAIN STEM OF THE WHITE RIVER: 1958-1982,
Indiana State Board of Health, Indianapolis.
T. E. Lauer, J. L. Winters, and H. L. BonHomme.
Proceedings of the Indiana Academy of Sciences, Vol. 93, p 181-186, 1983. 5 Fig, 13 Ref.

Descriptors: *Phytoplankton, *White River, *Indiana, Population dynamics, Water pollution effects, Nutrients, River flow, Algae.

The phytoplankton of the White River were monitored beginning in 1958. Sampling stations were concentrated above and below major population centers. Sampling locations have been moved upstream, downstream, added or deleted, based on the needs and resources of the study personnel. The original bench sheets from 1958 to 1974 were lost and all that remains for this period are the major grouping values. From 1975 to 1982 a more detailed evaluation of the phytoplankton community exists. Low mean phytoplankton densities correspond to high flow years 1959, 1961, 1968, 1969, 1972, 1974, and 1975. High phytoplankton densities were only found in 1960, 1962, 1963, 1971, and 1977 when flows were reduced. Phytoplankton densities as high as 200,000 cells/ml were found in some portions of the river. Nutrient point source loading comes from many places along the river. The cities of Muncie, Anderson and Indianapolis contribute the largest amounts. The phytoplankton populations appear to react to this nutrient loading. (Baker-IVI)
W85-06849

CHANGES OF PHYTOPLANKTON BIOMASS AND PRODUCTION IN A FIELD LAKE AND DRAINING CHANNEL,
Polish Academy of Sciences, Turew. Dept. of Agrobiology.
J. Jurkowska.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 4, p 341-352, 1984. 6 Fig, 4 Tab, 19 Ref.

Descriptors: *Phytoplankton, *Turew, *Poland, *Primary productivity, Lakes, Drainage channels, Nutrients, Biomass, Algae, Organic matter, Cyanophyta, Nanoplankton, Photosynthesis.

For the years 1980-1981 the biomass, structure and primary productivity of phytoplankton, as well as the destruction of organic matter were studied in two water bodies of different types, both situated in an area of intensive farming in the vicinity of Turew, Poland. One was a field lake, Lake Zbechy, and the other was an outflowing drainage channel. The biomass of the phytoplankton decreased and its composition changed. In the lake, a drop in the proportion of diatoms and blue algae in the phytoplankton biomass was paralleled by an increase in the proportion of nanoplankton. In the drainage channel, the participation of blue algae in the total biomass markedly dropped and that of nanoplankton rose. In the lake and channel both, the production and destruction of organic matter diminished. In both water bodies, the relative photosynthetic activity rose, owing to an increase in participation of intensely producing small forms. (Baker-IVI)
W85-06856

DENSITY AND BIOMASS OF BENTHIC CHIRONOMIDAE (DIPTERA) IN A LAKE AND MELIORATION CHANNEL, SITUATED IN AGRICULTURAL LANDSCAPE,
Polish Academy of Sciences, Poznan. Dept. of Agrobiology and Forestry.
J. Banaszak.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 4, p 353-363, 1984. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Population density, *Biomass, *Benthos, *Midges, *Lake Zbechy, *Poland, *Channels, Species composition, Species diversity, Lake sediments, Littoral zone, Profundal zone, Eutrophic lakes.

Studies were made of the occurrence and density of Chironomidae larvae in bottom sediments of the eutrophic and polymictic Lake Zbechy in western Poland and of the lake's outflowing melioration channel. The lake has a surface area of 108.9 ha, mean depth of 4.2 m and maximum depth of 7.5 m. Its banks are flat and without forest cover, being almost completely overgrown by Phragmitetum. Lake waters are drained off by the melioration channel through the peatbog bottom of a small glacial gully covered by meadows and cultivated soils. Mean breadth of the channel is 4.5 m and mean depth is 0.5 m. Marked faunistic differences between the littoral and profundal as well as between the lake and channel were found. The density of Chironomidae larvae in lake littoral and profundal zones was 1981.4 and 210.5 indiv./sq m, respectively. Chironomidae larvae biomass in lake littoral and profundal zones amounted to 2.0 and 0.5 g dry wt./sq m, respectively. In the lake, the

mean density of larvae was highest in the spring-summer period (May-June) and autumn-winter perid; it markedly dropped in the summer. The density of Chironomidae larvae was almost 4 times higher in the melioration channel as compared with the lake littoral zone; the channel had 7378.3 indiv./sq m and the biomass equaled 1.8 g dry wt./ sq m. The dominance of larvae of genus Chironomus s. str. (Ch. f.l. plumosus, Ch. semireductus) in the fauna of the profundal bottom sediments confirmed the eutrophic nature of Lake Zbechy. (Collier-IVI)
W85-06857

PHYTOPLANKTON OF LAKE SIMCOE DURING THE ICE-FREE PERIODS OF 1980-82 AND POTENTIAL RESPONSE TO REDUCED PHOSPHORUS LOADINGS,
Ontario Ministry of the Environment, Rexdale.
K. H. Nicholls, F. M. Forbes, R. Shaw, J. Humber, and L. Nakamoto.
Journal of Great Lakes Research, Vol. 11, No. 1, p 3-12, 1985. 10 Fig, 1 Tab, 37 Ref.

Descriptors: *Phytoplankton, *Lake Simcoe, *Ice, *Phosphorus loading, *Kempenfelt Bay, *Cook Bay, *Ontario, Biomass, Trophic status, Eutrophication, Water pollution effects, Visibility, Municipal wastewater.

Phytoplankton biomass and species composition during 1980-82 demonstrated a clear gradient in trophic status through Lake Simcoe ranging from most enriched in southern Cook Bay to least enriched in the open waters of the main lake. Inner Kempenfelt Bay and Cook Bay phytoplankton showed influence of the nutrient inputs in these regions. A clustering of phytoplankton similarity coefficients demonstrated that the lake contained identifiable regions with high percentage similarities linking sites a) located in proximity and/or b) in areas of the lake defined by similar conditions of nutrient loading and water depth. Two-dimensional ordinations of the ten dominant phytoplankton taxa at each of the nine sampling sites on the lake showed that the best definition of these regions was during the springtime when material inputs from point sources were greatest. After diversion of the two major municipal sewage sources out of the Lake Simcoe basin in lake 1984, calculations show the potential 'improvements' in trophic status of Cook Bay will be a 0.3 cu mm/L decline in average May-October phytoplankton biomass and an increase in Secchi disc visibility of about 80 cm. (Author's abstract)
W85-06860

SEDIMENTATION AND SEDIMENT RESUSPENSION IN LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 2J.
W85-06861

MODEL FOR LAKE-BAY EXCHANGE FLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
For primary bibliographic entry see Field 2L.
W85-06864

NOTE ON EUTROPHIC CHARACTERISTICS OF TWO FRESHWATER BODIES OF KURUKSHETRA, INDIA,
Kurukshetra Univ. (India). Dept. of Zoology.
M. P. Sharma.
Current Science, Vol. 53, No. 23, p 1263-1264, December, 1984. 9 Ref.

Descriptors: *Eutrophication, *India, *Lakes, *Primary productivity, *Zooplankton, Rotifers, Cladocerans, Copepods, Population dynamics, Trophic levels.

A regular and periodic sampling of water was taken during March 1977 through June of 1979 so as to collect information on population ecology for dominant zooplankton species in relation to conductivity, temperature, alkalinity, pH and dissolved oxygen. Rotifers were the most and least abundant component of zooplankton in Nabhkamal and Jyotisar (India), respectively. In the two successive years of study rotifers contribuued 58.22% and 46.88%, cladocerans 22.24% and 25.94%, and copepods 19.54% and 27.18% of the total zooplankton in Nabhkamal, whereas, in Jyotisar, cladocerans (58.87% and 70.10%) were followed by copepods (25.58% and 23.50%) and rotifers (15.55% and 6.40%). The annual mean number of total zooplankton was higher in Nabhkamal than in Jyotisar in the two succeeding years of study which probably could be due to differences in their trophic status. (Baker-IVI)
W85-06868

AQUATIC PARAMETERS AND LIFE HISTORY OBSERVATIONS OF THE GREAT BASIN SPADEFOOT TOAD IN UTAH,
Utah Univ., Salt Lake City. Dept. of Biochemistry.
P. Hovingh, B. Benton, and D. Bornholdt.
Great Basin Naturalist, Vol. 45, No. 1, p 22-30, January, 1985. 4 Fig, 1 Tab, 29 Ref.

Descriptors: *Toads, *Reptiles, *Utah, *Bonneville Basin, *Water chemistry, *Life history studies, Hydrogen ion concentration, Phenology, Life cycles, Dissolved solids, Precipitation patterns.

The distribution and breeding habitats of the Great Basin spadefoot toad (Scaphiopus intermontanus) were investigated in the Bonneville Basin of western Utah. The permanent springs and man-made-reservoirs used for breeding were largely found below the 1600 m elevation. pH ranged between 7.2 and 10.4 and total dissolved solids ranged between 170 and 4800 mg/l. The springs were less alkaline than the rain-filled reservoirs. The lack of aquatic vegetation was a common feature of the reservoirs and most of the springs. Observations of breeding without rain are noted as well as the lack of breeding with rain. The snout-vent lengths of adult spadefoots are greater in the Bonneville Basin than in other parts of the Great Basin. Utilization of permanent water sources and stimuli for emergence and breeding, as well as the larger adult size of S. intermontanus in the Bonneville Basin, are discussed in relation to the diverse precipitation patterns, the sparseness of the water sources, and the Holocene history of the Great Basin. (Author's abstract)
W85-06869

BIBLIOGRAPHY TO UPPER MISSISSIPPI RIVER AQUATIC AND WETLAND PLANT LITERATURE,
Arkansas Univ. at Little Rock. Dept. of Biology.
J. H. Peck, and M. M. Smart.
Proceedings of the Iowa Academy of Sciences, Vol. 92, No. 2, p 78-84, March, 1984. 308 Ref.

Descriptors: *Mississippi River, *Aquatic plants, *Wetlands, *Bibliographies, Vegetation, Aquatic vegetation, Limnology, Wildlife, Water management, Macrophytes.

This bibliography presents a reference resource to the extensive literature on aquatic and wetland plants of the Upper Mississippi River taken from journals, serials, books, agency reports, contracted agency reports, theses, and dissertations. The bibliography was compiled from 1977 to 1983. The 308 references were prepared by 270 authors. Topics considered included taxonomy, floristics, ecology, wildlife biology, limnological role, and management programs on macrophytes present in the navigation channel, backwater, and floodplain of the Upper Mississippi River, which stretches from Minneapolis, Minnesota, southward some 1,380 km to Cairo, Illinois. (Baker-IVI)
W85-06871

SPECTRAL ANALYSIS OF THE AUTOMATICALLY RECORDED DATA FROM SLAPY RESERVOIR, CZECHOSLOVAKIA,
Vyzkumny Ustav Vodohspodarsky, Prague (Czechoslovakia).
I. Nesmerak, and M. Straskraba.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 1, p 27-46, 1985. 12 Fig, 9 Tab, 9 Ref.

Descriptors: *Slapy Reservoir, *Czechoslovakia, *Reservoirs, Solar radiation, Temperature, Water temperature, Air temperature, Acidity, Spectral analysis, Limnology.

Data for solar radiation, air temperature, surface water temperature, and pH recorded at 0.5 hr intervals at Slapy Reservoir, Czechoslovakia, were subjected to spectral analysis. The complete series covered the month of July 1978. Three characteristic sections were distinguished. One of these was characterized by low variations, more irregular values and a slowly decreasing trend. Another showed high and regular variations as well as a steeply increasing trend. These sections were analyzed separately in addition to the complete series. The period of 24 hr was most important and represented for each of the parameters of solar radiation, air temperature, and acidity, 60, 38 and 18% of the total variances, respectively. The deterministic periodic component represented 65-96% of the total variance. The cross-correlation and cross-covariance between selected pairs of variables suggested lags of up to 4.5 hrs, the longest lag being observed for surface water temperature and solar radiation. An autoregressive model of the interrelation between the signals was formulated. This study is part of a project to develop a new methodology of ecological (particularly limnological) investigation aimed at overcoming some of the major drawbacks of present methodology. (Baker-IVI)
W85-06881

SCALING OF MICROCOSMS AND THE DIMENSIONAL ANALYSIS OF LAKES,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
D. Uhlmann.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 1, p 47-62, 1985. 10 Fig, 36 Ref.

Descriptors: *Dimensional analysis, *Lakes, *Microcosms, *Scaling functions, Reviews, Ecosystems, Model studies.

Different possibilities for designing and operating microcosms are reviewed. Examples of geometrical and of physiological similarity between systems of different sizes and the corresponding scaling functions have been considered. Examples of similarity analysis and scaling functions as applied to aquatic ecosystems are offered. It seems virtually impossible to base the scaling up of experimental results obtained with micro- and mesocosms once on a standardized set of similarity relations that permits the prediction of all of the essential structures and functions of the full-scale system. One problem which possibly may be partially solved in the near future is the estimation of the relations between underwater irradiance and phytoplankton growth. Scaling of light- and nutrient-dependent phytoplankton growth seems to be important in connection with the comprehensive work done on bioassays by numerous laboratories. In this connection, efforts should be made to obtain better correspondence between microcosms (or bioassays) and full scale systems also in regard of the dynamic response to changes in external conditions. A comparison between model and prototype should include the history of the study subjects, the length of transient periods in response to the forcing function, and the minimum time necessary to attain steady-state conditions. The design of microcosm experiments and the successful application of similarity analysis to scale up their results depend on both the particular goal and the proper identification and selection of the similarity criteria needed to achieve it. Prediction of the behavior of the full scale system is of limited interest only unless verification is possible by data obtained independently of the microcosm experiments. As far as whole lakes of different size are concerned, dimensional analysis indicates that there is no linear relationship between the intensity of the internal materials transport and the absolute depth and length. Thus shallow and deep lakes or small and large lakes may not be compared on a simple linear scale. The effect of water level fluctuation should also not be underestimated. (Baker-IVI)
W85-06882

NUTRIENT LOAD, TROPHIC CONDITION AND RESTORATION PROSPECTS OF LAKE MAGGIORE,
Istituto Italiano di Idrobiologia, Novara.
R. Mosello, and D. Ruggiu.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 1, p 63-75, 1985. 3 Fig, 6 Tab, 28 Ref.

Descriptors: *Lake Maggiore, *Italy, *Switzerland, *Trophic levels, *Lake restoration, Morphometry, Eutrophication, Nutrients, Oligotrophic lakes, Phosphorus, Nitrogen, Chlorophyll, Phytoplankton, Primary productivity.

An assessment of the trophic status of Lake Maggiore (Italy and Switzerland) is made in the light of its trophic evolution in the past few decades as a basis for possible restoration measures. Detailed studies made in the period 1978-1982 on the 17 main tributaries and the atmospheric inputs, as well as estimates relating to residual, undrained areas made it possible to evaluate the P and N loads. The in-lake status of nutrients, chlorophyll a, phytoplankton communities and primary production was monitored during the same period. Having verified that the values of morphometric and hydrological parameters, and of chemical and biological variables fall within the ranges of the OECD group of lakes, the applicability of the OECD approach to trophic assessment was ascertained through a comparison of measured and calculated values of selected variables. The lake is now meso-eutrophic, and a desirable reversion to the original oligotrophic state should be possible by reducing the present phosphorus imput by two thirds. A load reduction of one third could still bring about acceptable conditions. An integrated, whole-basin restoration strategy is emphasized as being best for a lake having a large watershed which includes a number of lakes, some of them highly eutrophic. (Baker-IVI)
W85-06883

DUCK BREEDING ECOLOGY AND HARVEST CHARACTERISTICS ON GRAND RIVER MARSH WILDLIFE AREA,
Wisconsin Dept. of Natural Resources, Madison.
W. E. Wheeler, R. C. Gatti, and G. A. Bartelt.
Technical Bulletin No. 145, 1984. 49 p, 22 Fig, 48 Tab, 86 Ref, 5 Append.

Descriptors: *Lakes, *Wildlife, *Waterfowl, *Wetlands, Ducks, Grand River Marsh, Wisconsin, Hunting, Recreation, Water management, Predation, Vegetation.

Seven lakes and five state wildlife areas, comprising 3% of the area within the 2500-sq mile Grand River Extensive Area (Wisconsin) accomodated up to 14% of the mallards, 30% of the blue-winged teal, and 21% of other species breeding within the area. The Grand River Marsh Wildlife Area represented 0.4% of the area investigated and attracted up to 3% and 6% of the total study area population of mallards and blue-winged teal, respectively. Thus a 100% increase in breeding mallards on public lands would increase population on the entire 2500-sq mile area by only 10%. A drawdown of the main flowage and removal of most carp-favored submergent vegetation, resulted in double the number of breeding ducks present during the pretreatment period. A nesting cover program apparently did not deter predation. Removal of predators did not improve nest success. Only 0.1% of the mallards and 0.5% of the blue-winged teal shot by hunters in the study area were hatched in the study area.
W85-06903

GEOLOGICAL CHARACTER AND MINERAL RESOURCES OF SOUTH CENTRAL LAKE ERIE,
Coastal Engineering Research Center, Fort Belvoir, VA.
S. J. Williams, and E. P. Meisburger.
Miscellaneous Report No. 82-9, October 1982. 62 p, 18 Fig, 2 Tab, 5 Ref, 3 Append. Project No. C31665.

Descriptors: *Lakes, *Sediments, *Beaches, *Dredging, Fill, Bottom sediments, Lake sediments, Presque Isle, Lake Erie, Sand, Gravel, Groins.

The bottom of southern Lake Erie was surveyed to identify deposits of sand and gravel available for dredging and deposition at beach nourishment projects on Presque Isle peninsula. The survey used seismic profiles, sediment cores, and grab samples. Suitable sand and gravel deposits were found in large quantities in two locales. At least 39 million cubic meters of material are witin 2.3 meters of the lake floor in a ridge between Long Point, Ontario, and Presque Isle. A second moraianal ridge off Dans Beach, west of Erie, has several million cu m. However, this source is close to shore and 25 km from Presque Isle.
W85-06907

DISTRIBUTION AND RELATIVE ABUNDANCE OF FISHES IN WISCONSIN: III. RED RIVER BASIN,
Wisconsin Dept. of Natural Resources, Madison.
D. Fago.
Technical Bulletin No. 143, 1984. 69 p, 4 Fig, 15 Tab, 19 Ref, 2 Append.

Descriptors: *Lakes, *Streams, *Fish, *Aquatic habitats, Species composition, Red Cedar River Basin, Wisconsin, Baseline studies, Environmental surveys, Fish populations, Populations, Habitats, Surveys, Watersheds, Agricultural watersheds, Species diversity, Aquatic life, Aquatic animals.

The distribution and relative abundance of fish species was studied at about 500 stations in the Red Cedar River basin, Wisconsin, from 1975 to 1981. The agricultural watershed is 4843 sq km in area, with 293 lakes and 2095 km of defined streams. A total of 97 species were identified in the 99,000 specimens. The five most common species were white sucker, bluegill, Johnny darter, yellow perch and bluntnose minnow. The most numerous species were bluegill, white sucker, bluntnose minnow, yellow perch, and common shiner. Rare species included 1 endangered species (crystal darter), 2 threatened species (Ozark minnow and blue sucker), and 7 watch species (lake sturgeon, American eel, pugnose shiner, weed shiner, redfin shiner, greater redhorse, and least darter). Twenty-nine species had not been reported in previous surveys of this basin. Two species, lake whitefish and flathead catfish, found in earlier surveys (1931 and 1963) were not detected in the present survey. The average number of species at one station was 10.
W85-06909

LAKE PONTCHARTRAIN AND VICINITY HURRICANE PROTECTION PLAN; REPORT 1: PROTOTYPE DATA ACQUISITION AND ANALYSIS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. G. Outlaw.
Technical Report HL-82-2, January 1982. Report 1 of a Series. 624 p, 14 Fig, 13 Tab, 263 Plates, 9 Ref, 5 Append.

Descriptors: *Lakes, *Water quality, *Hurricanes, *Tides, *Protection, Data acquisition, Surges, Storms, Lake Pontchartrain, Louisiana, Water currents, Wind, Saline water intrusion, Bonnet Carre Floodway, Floodways, Water level, Water circulation.

Prototype tidal elevation, current, and wind data were acquired and analyzed as a part of a study to evaluate the effects of the Lake Pontchartrain and Vicinity Hurricane Protection Plan on (a) tidal prism and circulation in Lake Pontchartrain, (b) hurricane surge levels in Lake Pontchartrain and vicinity, and (c) water quality in Lake Pontchartrain. Results of the analysis of prototype tidal elevation and current data will be used during verification of a numerical tidal circulation model. Data were included in the analysis from (a) an intensive tidal elevation and current data acquisition program for a duration of approximately 30 days; (b) a water quality program immediately following the intensive program, for monitoring tidal elevations, and, on a less extensive basis, currents, temperature, and conductivity in Lake Pontchartraia; and (c) a supplemental tidal elevation and current data acquisition program to provide additional data for numerical model verification. A water quality transect survey was conducted during both the intensive program and the supplemental survey for dissolved oxygen, pH, temperature, and conductivity. The intensive program also included a 25-hour current boat survey at six ranges in the tidal passes to Lake Pontchartrain and in the Inner Harbor Navigation Canal. Tidal analysis results show that the diurnal O1 and Kl constituents have the largest amplitude in Lakes Pontchartrain and Borgne and indicate that the diurnal tides in Lake Pontchartrain are co-oscillating with little change in constituent amplitude over the lake. (Author)
W85-06939

PHOSPHORUS DYNAMICS IN AN ARKANSAS RESERVOIR: THE IMPORTANCE OF SEASONAL LOADING AND INTERNAL RECYCLING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. H. Kennedy, R. H. Montgomery, W. F. James, and J. Nix.
Miscellaneous paper E-83-1, U.S. Army Environmental and Water Quality Operational Studies, May 1983. Final Report. 18 p, 8 Fig, 12 Ref.

Descriptors: *Phosphorus, *Lakes, *Fate of pollutants, *Water quality, *Reservoirs, *Recycling, *Storm runoff, *Lake sediments, *Seasonal variation, Stratification, Eutrophication, Path of pollutants, Iron, Sedimentation, Mixing, Thermocline, Seiches, Nutrients, Cycling nutrients.

During winter and spring, the majority of the annual P load enters DeGray Lake via storm inflows. P losses by sedimentation of allochthonous material in upstream reaches result in the establishment of longitudinal concentration gradients. Headwater sediments act as a source for P and Fe during anoxic periods. Entrainment of density inflows in or near the thermocline, convective mixing, and seiche activity provide the potential for material transport across the thermocline and may account for euphotic zone P increases observed in the upstream end of the lake during summer. The major P flux in fall is again from water column to sediment. These trends were alo reflected by changes in the chemical composition of sedimenting material collected in sediment traps. These data may provide a perspective from which to evaluate P dynamics in other lakes and reservoirs.
W85-06964

SEASONAL AND SPATIAL DISTRIBUTION OF ZOOPLANKTON IN A FLOOD CONTROL RESERVOIR AND TAILWATER,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
For primary bibliographic entry see Field 6G.
W85-06984

MASS CULTIVATION OF PLANKTONIC FRESHWATER ALGAE FOR THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER (EOM),
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Siedlungswasserwirtschaft.
B. Lusse, O. Hoyer, and C. J. Soeder.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 2, p 67-75, April, 1985. 8 Fig, 2 Tab, 31 Ref.

Descriptors: *Algae growth, *Extracellular organic mater, *Algae, Phytoplankton, Organic matter, Chlorophyta, Cyanophyta, Diatoms, Bacteria.

Extracellular organic matter (EOM) produced by phytoplankton serves as substrate for aquatic bacteria and thereby lead to an input of particulate feed and energy into the food chains of natural waters. Newly designed media were used successfully for the batch-wise massive culture of 3 green algae, 2 cyanobacteria and 2 diatoms in open race-

way miniponds of 0.25 cu m capacity. Green algae were also grown under chemstatic conditions. Except for cultures of the cyanobacterium Synechocystis salina, it was possible to recover EOM in total amounts of at least 2.5 g/sample. Since the algae always grew in the presence of various undefined types of bacteria, the amount of EOM present at any time was always the result of EOM release from the algae and EOM utilization by bacteria that must have consumed at least the EOM components most readily to be metabolized. Presence of bacteria in the experimental cultures has been one attempt to approximate towards natural conditions; the attempt to simulate the ionic environment in a productive surface water was another. (Baker-IVI)
W85-07026

EXPERIMENTAL INVESTIGATION OF INTRUSIVE GRAVITY CURRENTS ENTERING STABLY STRATIFIED FLUIDS,
Karlsruhe Univ. (Germany, F.R.). Sonderforschungsbereich Ausbreitungs- und Transportvorgaenge in Stroemungen.
K. M. Faust, and E. J. Plate.
Journal of Hydraulic Research, Vol. 22, No. 5, p 315-325, 1984. 9 Fig, 1 Tab, 17 Ref.

Descriptors: *Density stratification, *Gravity currents, *Stratification, *Saline water intrusion, Intrusions, Reservoirs, Lakes, Oceans, Density, Viscosity, Model studies, Mathematical models, Velocity.

Fluid intrusions into a stably stratified environment due to density differences can be observed in reservoirs, lakes, in the atmosphere, and also in the ocean. Laboratory experiments were carried out in a water tank to study the influence of fluid depth, initial density differences, shape of initial density distribution, time and viscosity on velocity and thickness of such intrusions. The influence of the density gradient at the intrusion level can be described by an empirical function. The case of a very sharp interface gradient is compared with previously published results and with boundary gravity currents. A continuously linearly stratified ambient, on the other hand, allows a comparison with the case of the so-called mixed region collapse. Only for these extreme cases does there exist close agreement of theoretical models and experiments and it must be concluded that intrusions are not yet fully understood theoretically. For the intrusions along a sharp interface, Benjamin's energy conserving analysis which was extended by Holyer and Huppert approximately describes the oberved behavior, whereas intrusions into a linearly stratified environment behave very differently from theoretical calculations. Furthermore, Reynolds-number effects seem to play an important role in intrusive flow modelling. (Baker-IVI)
W85-07028

EVALUATION OF A COMMUNITY-BASED INDEX USING BENTHIC INDICATOR-ORGANISMS FOR CLASSIFYING STREAM QUALITY,
Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
For primary bibliographic entry see Field 5A.
W85-07046

VERTICAL LIGHT ATTENUATION AND PHYTOPLANKTON DEVELOPMENT IN LAKE ZURICH,
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
F. Schanz.
Limnology and Oceanography, Vol. 30, No. 2, p 299-310, March, 1985. 7 Ref, 2 Tab, 49 Ref.

Descriptors: *Phytoplankton, *Lake Zurich, *Switzerland, *Light penetration, *Lakes, Biomass, Light intensity, Chlorophyll a, Epilimnion, Thermocline.

Many light-depth profiles based on measurements of photosynthetically available radiation (PAR) in the 0-20 m zone of Lake Zurich (Switzerland) were analyzed with respect to phytoplankton development in the epilimnion and the thermocline. Variations in the average value of the vertical attenuation coefficient with time were closely related to variations in biomass. Inspection of the depth distribution of the natural logarithms of light intensity reveals several straight-line segments. These correspond to zones with differing phytoplankton densities. During the spring bloom and the late summer phytoplankton maximum the biomass development can be followed in detail by interpreting the light-depth curves. The results show that the vertical attenuation coefficient Kd(PAR) is influenced considerably by chlorophyll a; nonchlorophyll-related organic and inorganic suspensoids, however, also seem to be of some importance during periods of low productivity. (Author's abstract)
W85-07069

NUTRIENT INTERNAL CYCLING AND THE TROPHIC REGULATION OF GREEN LAKE, WISCONSIN,
Maine Univ. at Orono. Dept. of Geological Sciences.
R. E. Stauffer.
Limnology and Oceanography, Vol. 30, No. 2, p 347-363, March, 1985. 9 Fig, 9 Tab, 65 Ref.

Descriptors: *Cycling nutrients, *Trophic status, *Green Lake, *Wisconsin, *Diatoms, *Nutrients, Silica, Nitrogen, Phosphorus, Lakes, Dissolved oxygen, Seasonal variation, Limiting nutrients.

Algal nutrients (Si, N, P) and dissolved oxygen were studied in Green Lake, Wisconsin, in 1971-1972, and in 1978-1980 following a reduction of about 35% in total external P loading in December 1976. Despite oxic conditions, there is more P in the hypolimnion than would be expected from the dissolved oxygen and from classical Redfield stoichiometry. Because of a metalimnetic dissolved oxygen minimum in late summer, the calculation and interpretation of the hypolimnetic oxygen deficit is affected by turbulent transport of dissolved oxygen. Vertical fluxes of P into the mixed layer are important in late spring and early summer, but, owing to metalimnetic P depletion, are negligible between mid-July and mid-October. Vertical transport of Si into the mixed layer is negligible in summer and early fall compared with inputs from the land drainage basin. Although P is high at spring turnover, epilimnetic concentrations of P are low and Secchi transparency is high by mid-to-late summer. These seasonal changes are caused by sedimentation of P and low seasonal inputs from the drainage basin. This P is recovered in the hypolimnion and recirculated throughout the lake at fall overturn. It causes silica limitation of the diatom bloom each succeeding spring. The total P content of Green Lake and its seasonal partition among the layers were remarkably stable between 1971 and spring 1980, despite the reduction in external loading in 1976. The hypolimnetic oxygen deficit also showed no significant change between the first and eighth decades of this century. (Author's abstract)
W85-07070

DOES SETTLING SESTON RELEASE SOLUBLE REACTIVE PHOSPHORUS IN THE HYPOLIMNION OF LAKES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland). Inst. of Aquatic Sciences.
R. Gachter, and A. Mares.
Limnology and Oceanography, Vol. 30, No. 2, p 364-371, March, 1985. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Seston, *Phosphorus, *Hypolimnion, *Lake sediments, *Lake Lucerne, *Switzerland, Particulate matter, Organic matter, Carbon, Stratification, Sediments, Anaerobic conditions, Mineralization.

Organic material collected with sediment traps at depths of 20, 40, and 60 m in mesotrophic, phosphorus-limited Lake Lucerne (Switzerland) was decomposed aerobically at a rate of about 0.01/day at 6 C. However, this material is not a source, but rather a sink, for soluble reactive phosphorus (SRP). As a consequence, during stratification, in the upper part of the hypolimnion concentrations of oxygen and SRP decrease simultaneously, and the ratio POC:PP (particulate organic carbon: particulate phosphorus) decreases significantly with increasing sampling depth and hence with increasing age of the seston. Once deposited at the aerobic sediment surface, the particulate matter continues to accumulate SRP. Since settling particles and the aerobic sediment surface both act as sinks for SRP, anaerobic subsurface sediments are the only possible source for the SRP accumulating in the hypolimnion during summer stagnation. The aerobic sediment layer may however become an apparent source for SRP if the supply from deeper anoxic sediments exceeds its biological-chemical sorption capacity. These observations and additional information from the literature indicate that in phosphorus-limited lakes decomposing organisms do not release, but rather take up, SRP while mineralizing phosphorus-poor organic material. (Author's abstract)
W85-07071

VARIATIONS IN MELOSIRA ISLANDICA VALVE MORPHOLOGY IN LAKE ONTARIO SEDIMENTS RELATED TO EUTROPHICATION AND SILICA DEPLETION,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
E. F. Stoermer, J. A. Wolin, C. L. Schelske, and D. J. Conley.
Limnology and Oceanography, Vol. 30, No. 2, p 414-418, March, 1985. 2 Fig, 13 Ref. EPA grant R810396, NSF grant OCE 82-16588.

Descriptors: *Diatoms, *Melosirsa, *Silica, *Eutrophication, *Lake Ontario, *Great Lakes, *Lake sediments, Water pollution effects, Taxonomy, Paleolimnology, Plant morphology, Phosphorus, Nutrients.

Variation in valve morphology of the freshwater plankton diatom Melosira islandica has led to taxonomic confusion in the limnological literature. Different types of valves were found in Melosira islandica populations preserved in Lake Ontario sediment cores. Three morphotypes were distinguished, the more coarsely structured of which are most abundant in assemblages deposited before 1840. Finely structured forms become more abundant upcore, reaching maximum abundance ca. 1962. The morphological modifications and the decline in biogenic silica accumulation could be attributed to toxic materials entering the Lake Ontario system; however, no specific observational or experimental evidence is known that would support this hypothesis. The changes appear to be related to increased phosphorus loading and consequent silica depletion in Lake Ontario waters. Once silica limitation occurs, the accumulation of diatom frustules is diminished both by the decrease of diatom production and by enhanced dissolution and internal recycling of the available silicon pool. The accumulation of diatom frustules in sediments thus becomes an approximate function of external silicon loading and not of production or of the external supply of phosphorus or other controlling nutrient. The morphological changes in M. islandica may provide a clear index of silicon availability and thus provide a valuable paleolimnological tool for evaluating the nutrient status of lakes in the past. If this index is applied to the Lake Ontario core studied, it implies that maximum phosphorus loading and silica limitation occurred during the 1960's and early 1970's and that efforts to reduce phosphorus loading in the early 1970's were becoming increasingly effective by 1979. (Author's abstract)
W85-07072

SURFACE WAVES IN BASINS OF VARIABLE DEPTH,
California Univ., San Diego, La Jolla. Inst. of Geophysics and Planetary Physics.
J. Miles.
Journal of Fluid Mechanics, Vol. 152, p. 379-389, March, 1985. 1 Fig, 18 Ref.

Descriptors: *Basins, *Surface waves, *Seiches, Waves, Differential equations, Water depth.

The linearized boundary-value problem for surface waves of frequency w in a closed basin of variable depth is reduced to a non-self-adjoint partial differential equation in the plane of the free surface. The corresponding variational form for the eigenvalue k = w(2)/g is constructed. A self-adjoint partial differential equation, for which the variational form is the Raleigh quotient also is constructed. It offers significant advantages over the non-self-adjoint formulation, but at the expense of a more complicated operator. Three relatively simple variational approximations are constructed, two for a class of basins with sloping sides and the third for basins for which the variation of the depth relative to its mean is small. These general results are illustrated by comparison with Rayleigh's results for a semicircular channel, Sen's inverse results for a family of circular basins, and Lamb's results for a shallow circular paraboloid. The eigenvalue for the dominant mode in the paraboloid is determined. (Baker-IVI)
W85-07085

IMPACT OF NITROGEN AND PHOSPHORUS ON (14C)-LIGNOCELLULOSE DECOMPOSITION BY STREAM WOOD MICROFLORA,
Oregon State Univ., Corvallis. Dept. of Microbiology.
N. G. Aumen, P. J. Bottomley, and S. V. Gregory.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1113-1118, May, 1985. 4 Fig, 1 Tab, 29 Ref. NSF grants DEB80-04652, DEB80-12162, DEB80-22634 and DEB81-12455.

Descriptors: *Lignocellulose, *Decomposition, *Stream biota, *Nitrogen, *Phosphorus, Streams, Temperature effects, Wood, Detritus, Microorganisms.

Nutritional and physical factors affecting the decomposition of (C-14)lignocellulose prepared from Douglas fir (Pseudotsuga menziesii) were examined by incubating the labeled substrate with homogenized surface wood scrapings obtained from a Douglas fir log in a Pacific Northwest stream. Decomposition rates of lignocellulose were greater in each of four filter-sterilized sources of stream water than in distilled water alone. Cellulose decomposition was stimulated 50% by the addition of either potassium nitrate or KH2PO4/K2HPO4 and further enhanced (167%) by a combination of both. Lignin decomposition was stimulated 65% only by the addition of both N and P. Lignocellulose decomposition was greatest when supplemental potassium nitrate was supplied in concentrations of at least 10.0 mg of N/liter but not increased further by higher concentrations. The decomposition of lignocellulose increased as the incubation temperature was raised and NO3(-)-N supplementation further increased these rates between three and seven fold over the range of temperatures examined (5 to 22 C). Accumulation of NH4(+) was always observed in culture filtrates of incubations which had been supplemented with KNO3, the quantity being independent of NO3(-) concentrations greater than or equal to 10 mg of N/liter. The role of supplemental NO3(-) in the decomposition of lignocellulose is discussed in relation to wood decomposition and the low concentrations of N found in stream ecosystems of the Pacific Northwest. (Baker-IVI)
W85-07136

NITROGEN DYNAMICS IN STREAM WOOD SAMPLES INCUBATED WITH (14C)LIGNOCELLULOSE AND POTASSIUM (15N)NITRATE,
Oregon State Univ., Corvallis. Dept. of Microbiology.
N. G. Aumen, P. J. Bottomley, and S. V. Gregory.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1119-1123, May, 1985. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Nitrogen cycle, *Streams, *Lignocellulose, Nitrates, Decomposition, Wood, Detritus, Nutrients.

Surface wood samples obtained from a Douglas fir log (Pseudotsuga menziesii) in a Pacific Northwest stream were incubated in vitro with lignocellulose in a defined mineral salts medium supplemented with 10 mg of N/liter of NO3(-). The organic N content of the lignocellulose-wood sample mixture had increased from 132 micro-g of N to a maximum of 231 micro-g of N per treatment after 6 days of incubation. Rates of lignocellulose decomposition were greatest during the first 6 days. Total CO2 evolution was highest at day 6. Filtrate NH4(+)-N increased from background levels to a final value of 57 micro-g of N/treatment. Filtrate NO3(-)-N completely disappeared by day 6 and organic N showed a slight decline between days 12 and 18. The majority of the N-15 that could be recovered appeared in the particulate organic fraction by day 6, and the filtrate NH4(+)-N fraction contained 11 micro-g of N-15 by day 18. The N-15 enrichment values of the filtrate NH4(+) and the inorganic N associated with the particulate fraction had increased to about 20 atom % N-15 by 18 days of incubation, whereas the particulate organic fraction reached its highest enrichment by day 6. Measurements of N2 fixation and denitrification indicated an insignificant gain or loss of N from the experimental system by these processes. Woody debris in stream ecosystems might function as a rapid and efficient sink for exogenous N, resulting in stimulation of wood decomposition and subsequent activation of other N cycling processes. (Baker-IVI)
W85-07137

SURVEY FOR VIRUSES FROM FRESH WATER THAT INFECT A EUCARYOTIC CHLORELLA-LIKE GREEN ALGA,
Nebraska Univ.-Lincoln. Dept. of Plant Pathology.
J. L. Van Etten, C. H. Ban Etten, J. K. Johnson, and D. E. Burbank.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1326-1328, May, 1985. 2 Tab, 11 Ref. DOE grant DE AC02-82-ER12086 and Public Health Service grant GM-32441.

Descriptors: *Plant viruses, *Chlorophyta, Chlorella, Ponds, Streams, Algae, Water analysis, Plant pathology, Viruses.

Twenty freshwater samples were collected from ponds and streams in different geographical regions in the US and assayed for viruses. Four of the 20 samples produced plaques on Chlorella strain NC64A lawns. The virus titer in these water samples varied from 60 to 40000 PFU/ml. A few of the plaques were picked from each of the four samples and partially characterized. All viruses were similar to the polyhedral virus PBCV-1 with regard to host range, morphology and sensitivity to organic solvents. The viruses reacted with PBCV-1 antiserum and the viral DNAs hybridized extensively with PBCV-1 DNA. The ease with which these new lytic viruses were found suggests that viruses which infect this particular strain of Chlorella and possibly other eucaryotic algae are common in freshwater environments. Thirty-five water samples collected in 10 states were assayed for plaque-forming ability on Chlorella strain NC64A. Thirteen of the samples from five states contained at least 1 PFU/10 ml of fresh water. All produced sharply defined, clear plaques. The development of a plaque assay for these eucaryotic algal viruses allows it to be established that large, double stranded DNA-containing viruses are common in aquatic environments. The virus population fluctuates both qualitatively and quantitatively with time in these environments. The role that these viruses play in their aquatic environments is completely unknown. (Baker-IVI)
W85-07138

SPECIFIC UPTAKE RATES OF AMINO ACIDS BY ATTACHED AND FREE-LIVING BACTERIA IN A MESOTROPHIC LAKE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. Simon.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1254-1259, May, 1985. 3 Flg, 3 Tab, 40 Ref.

Descriptors: *Bacteria, *Amino acids, *Mesotrophic lakes, *Lake Constance, Lakes, Seasonal variation, Spatial distribution, Population dynamics, Chlorophyll a, Vertical distribution.

Attached bacteria and small (0.2 to 1.0 micro-m) and large (1.0 to 3.0 micro-m) free living bacteria are compared in terms of specific uptake rates of amino acids in an investigation of their seasonal and vertical fluctuations in Lake Constance. They are also compared with specific uptake rates based on numbers of active cells as shown by autoradiography. Lake Constance was thermally stratified from mid-June to November. The seasonal patterns of the bacterial cell counts correlated only weakly with the net uptake rates of amino acids and the chlorophyll a concentration. Pronounced peaks of the cell counts occurred about 1 week after the peaks of chlorophyll a. The net uptake rates of amino acids correlated fairly well with chloropyll a concentration. High percentages of total cell counts in the fraction 0.2 to 1.0 micro-m occurred between the lake surface and a depth of 20 m and lower percentages occurred below 20 m with a few exceptions. Seasonal patterns of active bacteria were closely related to the net uptake rates of amino acids and the total cell counts. The specific activity index, used as specific uptake rates of amino acids, is a useful indicator of the metabolic activity of different fractions of the bacterial population. If based on acridine orange direct count (AODC) the fluctuations of specific uptake rates for attached bacteria are greatest and those for small free-living bacteria are lowest. At most times and depths, the specific activity of attached bacteria exceeds that of free-living bacteria if based on AODC. If the specific uptake rates for free-living bacteria are based on autoradiographic cell counts, they are in the same range as those for attached bacteria based on AODC. Only the most active free-living cells are counted in this case. A differentiation between small and large free-living bacteria revealed that the seasonal and vertical patterns of their activity differ, although their specific activity index is of the same order of magnitude. (Baker-IVI)
W85-07139

LAKE UNTERSEE, A FIRST ISOTOPE STUDY OF THE LARGEST FRESHWATER LAKE IN THE INTERIOR OF EAST ANTARCTICA,
Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung.
W.-D. Hermichen, P. Kowski, and U. Wand.
Nature, Vol. 315, No. 6015, p 131-133, May, 1985. 3 Fig, 1 Tab, 29 Ref.

Descriptors: *Lake Untersee, *Antarctica, *Isotope studies, Ice cover, Lake ice, Polar regions, Hydrology, Thermal properties, Water chemistry, Sublimation, Melting, Glaciers.

Perennially ice-covered lakes partially bounded by glacier ice are common in some Antarctic coastal regions but very rare inside the continent. Hydrological studies on the largest freshwater lake of interior Antarctica, Lake Untersee (71 degrees 20' S/13 degrees 30' E, surface area 10 sq km, maximum depth > 79 m), show that the lake arose from a melt-water pond during climatic optimum periods in the Holocene. At present, the studied water body is thermally, hydrogeochemically and isotopically homogeneous because of thermal convection during the austral summer. Lake Untersee is fed throughout the year by underwater melting of the adjoining glacier ice. Isotope data suggest a permanent ice cover during its existence. The drainless lake is constantly losing water through sublimation on the surface of the more than 2.5-m-thick ice cover. The salt content suggests that the present water body is the remainder of an amount of melt water at least 50 times as great. (Author's abstract)
W85-07142

EFFECTS OF FLUSHING RATE ON PHOSPHORUS RETENTION IN AN AQUATIC BIOME,
Kashmir Univ., Srinagar (India). Dept. of Botany.
V. Kaul, M. Isaac, and S. N. Pandita.
Environmental Conservation, Vol. 11, No. 4, p 360-362, Winter, 1984. 3 Fig, 11 Ref.

Descriptors: *Phosphorus retention, *Flushing rate, *Lakes, *Dal Lake, *Kashmir, *India, Eu-

trophication, Evapotranspiration, Water budget, Phosphorus.

The effects of flushing rate on phosphorus retention were investigated over a period of one year on Dal Lake, situated at 1,587 meters above MSL in Srinagar, Kashmir, which has a submediterranean climate. Total phosphorus loading to the Lake reached a peak in the month of June, 1.46 g per sq m per month, followed by 1.18 g per sq m per month in July. Monthly flushing rates of water, calculated from the water budget of the Lake, showed the peak value of 3.9 times for May, primarily due to increased input of water in this month as a result of frequent rains coupled with the snow melt in the upper reaches of the mountainous catchment. P-loading to the Lake from March to July is high, but simultaneously the flushing rate is also comparably high, thereby counterbalancing the former. Statistical analysis reveals a positive correlation between flushing rate of water and P-loading, a negative correlation between flushing rate and retention coefficient of phosphorus, and a negative correlation between P-loading and retention coefficient of phosphous. Evidently the high flushing-rate is a great check on phosphorus accumulation in the system, working in unison with some other natural mechanisms that are operative for removal of phosphorus from the system, which does not show signs of advanced eutrophication. (Baker-IVI)
W85-07147

2I. Water In Plants

MICROCLIMATE OF A RAINFALL SHELTER,
Texas Agricultural Experiment Station, Temple. Blackland Research Center.
W. A. Dugas, Jr., and D. R. Upchurch.
Agronomy Journal, Vol. 76, No. 6, p 867-871, November-December, 1984. 4 Fig, 5 Tab, 4 Ref.

Descriptors: *Microclimate, *Rainfall shelters, Wind, Air temperature, Relative humidity, Canopy, Solar radiation, Water stress, Experimental apparatus, Climate.

To induce water stress on crops grown in areas where extended periods without precipitation during the growing season are infrequent, rainfall shelters are increasingly being used. Shelters are moved over plots during or previous to precipitation. The microclimatic effects of a large (18 x 48 m) fiberglass shelter near Temple, TX were investigated. Air temperature, solar radiation, wind speed, and relative humidity measurements were made throughout two growing seasons to determine the effect of the shelter on the canopy microclimate (relative to the microclimate outside the shelter) when the shelter off and over the plots. When the shelter was over the plots, the effects upon wind speed and radiation, which were affected most, were consistent; radiation was reduced from 30 to 40% and, because of shelter design, wind speed was reduced to nearly zero. Generally, air temperature and humidify effects were dependent upon temperature and radiation levels. Air temperature differentials greater than 6 C developed within an hour after movement of the shelter over the plots, while radiation and wind effects occurred instantaneously. When off the plots, the shelter's microclimatic effects were not detectable. Under certain conditons, however, the shelter may significantly affect the microclimate. Therefore, researchers using shelters need to investigate the microclimate under a shelter for proper interpretation of plant responses to the environment. (Author's abstract)
W85-06185

EFFECT OF FURROW DIKING, SUBSOILING, AND SLOPE POSITION ON CROP YIELDS,
Texas Agricultural Experiment Station, Vernon.
For primary bibliographic entry see Field 3F.
W85-06186

LUXURY WATER USE BY BERMUDAGRASS TURF,
Arizona Univ., Tucson. Coll. of Agriculture.
For primary bibliographic entry see Field 2D.
W85-06189

AGROCLIMATIC CLASSIFICATION OF THE SEMI-ARID TROPICS III. CHARACTERISTICS OF VARIABLES RELEVANT TO CROP PRODUCT POTENTIAL,
Food and Agriculture Organization of the United Nations, Maputo (Mozambique).
S. J. Reddy.
Agricultural Meteorology, Vol. 30, No. 4, p 269-292, January, 1984. 9 Fig, 5 Tab, 23 Ref.

Descriptors: *Soil water, *Semiarid climates, *Crop production, *India, Crop yield, Climate, Soil properties, Temperature effects, Seasonal variation, Rainfall.

Based on a comparison between agroclimatic variables, soil water balance simulation results and crop performance results at selected Indian locations, successful cropping systems on similar soil types with different levels of dependability were identified. With high variability in both the onset and cessation times of the rainy season, then, if the effective rainy period is short (less than 8 weeks) and with early sowing rains, a long duration single crop or intercroping should be adopted, but if these rains are late then a single crop should be grown in alfisols and in the vertisols a rabi single crop should follow a fallow kharif. Or, if the effective rainy period is moderately long (8-13 weeks) and with early sowing rains, intercropping should be adopted, but if these rains are late a single crop should be grown in alfisols, and in vertisols either double cropping or intercropping should be practiced. Under more stable onset and cessation times for sowing rains with a short effective rainy period a single crop should be grown; with a moderate effective rainy period, intercropping should be adopted in alfisols and double cropping in verisols; with a long effective rainy period, double cropping is preferable. (Baker-IVI)
W85-06190

GROWTH BEHAVIOUR OF FIELD GROWN SUGARCANE VARIETIES IN RELATION TO ENVIRONMENTAL PARAMETERS AND SOIL MOISTURE STRESS,
Sugarcane Breeding Inst., Coimbatore (India).
S. Venkataramana, S. Shunmugasundaram, and K. M. Naidu.
Agricultural and Forest Meteorology, Vol. 31, No. 3/4, p 251-260, June, 1984. 3 Tab, 13 Ref.

Descriptors: *Soil water, *Moisture stress, *Plant growth, *Sugarcane, Humidity, Rainfall, Soil properties, Drought resistance, Crop yields, Temperature.

Growth analysis has been used to evaluate various sugarcane varieties for their drought resistance capacity under field conditions. The net assimilation rate I(NAR), which is singularly responsible for growth, was high during the tillering and grand growth period, but declined sharply with the age of the crop. Correlations between weather parameters and growth characteristics have indicated a few salient points. Air temperature and soil temperature possessed a positive correlation with NAR while relative humidity, rainfall and number of rainy days were negatively correlated. Relative growth rate (RGR) was lowered with rise in relative humidity (RH) percent but increased with high air and soil temperature. Leaf area ratio (LAR) was positively related to temperature while RH% had negative association. Specific leaf weight (SLW) and specific leaf area (SLA) were not uniform during crop growth under both normal irrigation and drought conditions. Since sugarcane grows well in warmer climates, radiation coupled with temperature influenced the growth during the early phase. Thus, during the maturity phase the growth parameters did not linearly respond to the changing environmental variables. (Baker-IVI)
W85-06192

SOME SENSITIVITY RESULTS FOR CORN CANOPY TEMPERATURE AND ITS SPATIAL VARIATION INDUCED BY SOIL HYDRAULIC HETEROGENEITY,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
B. J. Choudhury, and C. A. Federer.
Agricultural and Forest Meteorology, Vol. 31, No. 3/4, p 297-317, June, 1984. 14 Fig, 45 Ref.

Descriptors: *Soil-water-plant relationships, *Spatial distribution, *Crop yield, *Corn, *Air temperature, *Canopy, effects, Soil properties, Simulation, Model studies, Soil hydraulic properties.

A simulation model is developed for canopy-air temperature difference for a sweet corn crop and use in sensitivity studies for canopy temperature and its spatial variation induced by soil hydraulic heterogeneity. Simulations are done using mostly clear sky atmospheric parameters, primarily because space-borne infrared sensors would be unable to provide surface temperatures under cloudy conditions. Combining the Montieth transpiration equation with both uptake from a single-layered root zone and change in internal storage of the plant, the continuity equation for water flux in the soil-plant-atmosphere system was solved. The canopy temperatures are obtained from the energy balance equations. The scaling theory is used to model the spatial variability of soil hydraulic properties, and dynamic equations for plant storage water and root zone soil water are used to simulate soil drying and resulting spatial variation of canopy temperatures. (Baker-IVI)
W85-06193

WATER USE BY TAMARILLOS (CYPHOMANDRA BETACEA) WITHIN A SHELTERED ORCHARD ENVIRONMENT,
Ruakura Soil and Plant Research Station, Hamilton (New Zealand).
M. J. Judd, and K. J. McAneney.
Agricultural and Forest Meteorology, Vol. 32, No. 1, p 31-40, July, 1984. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Water use, *Plant growth, *Orchards, *Tamarillos, Canopy, Evaporation, Advection, Transpiration, Solar radiation, Shelter.

The tamarillo is a small sub-tropical tree which is apparently grown as a horticultural crop only in New Zealand. Excision experiments were used to provide a direct measurement of the transpiration of tamarillos within a sheltered orchard. Problems experienced by others through trunk expansion associated with excess water uptake appear minimal, perhaps because of the well watered environment. While the effects of repeated rows of shelter on turbulent transport processes are unknown, the water uptake data presented indicate that they tend to decouple the orchard environment from overhead conditions. This has the result of reducing the influence of the overhead vapor-pressure deficit and consequently tying transpiration closer to net radiation and hence the equilibrium condition. (Baker-IVI)
W85-06195

STABILITY OF NON-WATER-STRESSED BASELINES,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2D.
W85-06198

STOMATAL CONDUCTANCE AND PHOTOSYNTHESIS IN WATER HYACINTH: EFFECTS OF REMOVING WATER FROM ROOTS AS QUANTIFIED BY A FOLIAGE-TEMPERATURE-BASED PLANT WATER STRESS INDEX,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
S. B. Idso, P. J. Pinter, Jr., R. J. Reginato, and K. L. Clawson.
Agricultural and Forest Meteorology, Vol. 32, No, 3/4, p 249-256, September, 1984. 6 Fig, 14 Ref.

Descriptors: *Water stress, *Water hyacinth, *Stomatal conductance, *Photosynthesis, Leaves, Roots, Temperature, Irrigation practices, Stomatal transpiration, Aquatic plants.

Stomatal conductance and net photosynthesis measurements were made over a period of a week in mid-October on two stands of water hyacinths floating in sunken metal stock tanks at Phoenix, Arizona. On the second day of the experiment, all free water in one of the tanks was removed. Foliage temperature measurements were subsequently used to quantify the water stress experienced by the water robbed plants. A plant water stress index derived from the foliage temperature and air vapor pressure deficit data was then used to study the effects of developing water stress on the plant physiological parameters being measured. Detectable levels of water stress did not occur until the day following water removal, and water stress did not become maximal until five days later. Information gained can be useful for farm management practices, particularly about irrigation schemes. (Baker-IVI)
W85-06200

APPLE ROOT DISTRIBUTION AS EFFECTED BY IRRIGATION AT DIFFERENT SOIL WATER LEVELS ON TWO SOIL TYPES,
Department of Agriculture, Potchefstroom (South Africa).
For primary bibliographic entry see Field 3F.
W85-06205

STRESS TOLERANCE IN SOYBEANS. I. EVALUATION OF THREE SCREENING TECHNIQUES FOR HEAT AND DROUGHT TOLERANCE,
Kansas State Univ., Manhattan. Dept. of Agronomy.
M. Bouslama, and W. T. Schapaugh, Jr.
Crop Science, Vol. 24, No. 5, p 933-937, September-October, 1984. 1 Fig, 8 Tab, 19 Ref.

Descriptors: *Water stress, *Drought resistance, *Plant growth, *Soybeans, Heat tolerance, Osmotic pressure.

The genetic variability among 20 soybean cultivars subjected to drought stress were evaluated and a determination was made as to whether these parameters are effective criteria to select for drought and heat tolerance. Three screening techniques were used: first, germinating seed in polyethylene glycol-600 (PEG) at -0.6 MPa osmotic pressure; second, subjecting seedlings to PEG-600 at -0.6 MPa osmotic pressure in hydroponic solution for 14 days; and third, a heat tolerance test based on the cellular membrane thermostability. Two of the 20 cultivars tested were relatively drought tolerant, 2 were relatively susceptible, and the remaining cultivars fell into an intermediate group. The hydroponic seedling and heat tolerance tests gave highly significant correlated findings, including that both drought and heat tolerance were identified in the same cultivars under the condition of the study. The seed germination test may not be used as a reliable procedure for identifying drought tolerant cultivars as it tends to reflect differences in seed quality and has no relation to field performance. The hydroponic seedling test seemed to be the most reliable and potentially useful as a means for screening for drought tolerance in soybeans. (Baker-IVI)
W85-06206

EVIDENCE OF FLOODS ON THE POTOMAC RIVER FROM ANATOMICAL ABNORMALITIES IN THE WOOD OF FLOOD-PLAIN TREES,
Geological Survey, Reston, VA. Water Resources Div.
T. M. Yanosky.
Available from Distr. Br., USGS, 604 S. Pickett St., Alex., Va. 22304. USGS Professional Paper 1296, 1983. 42 p, 18 Fig, 9 Tab, 9 Ref.

Descriptors: *Flood plain, *Flood damage, Vegetation growth, *Ash trees, Floods, Vascular tissues, Woody tissues, *Flood rings, Botanical evidence, *Potomac River, Wood anatomy, Anomalous plant growth, Tree rings.

Ash trees along the Potomac River flood plain near Washington, D.C., were studied to determine changes in wood anatomy related to flood damage, and anomalous growth was compared to flood records for April 15 to August 31, 1930-79. Collectively, anatomical evidence was detected for 33 of the 34 growing-season floods during the study period. Evidence of 12 floods prior to 1930 was also noted, including catastrophic ones in 1889 and 1924. Trees damaged after the transition from earlywood to latewood growth typically formed 'flood rings' of enlarged vessels within the latewood zone. Trees damaged near the beginning of the growth year developed flood rings within, or contiguous with, the earlywood. Both patterns are assumed to have developed when flood-damaged trees produced a second crop of leaves. Trees damaged by high-magnitude floods developed well formed flood rings along the entire height and around the entire circumference of the stem. Small floods were generally associated wtih diffuse or discontinuous anomalies restricted to stem apices. Frequency of flood rings was positively related to flood magnitude, and time of flood generation during the tree-growth season was estimated from the radial position of anomalous growth relative to annual ring width. Reconstructing tree heights in a year of flood-ring formation gives a minimum stage estimate along local stream reaches. Some trees provided evidence of numerous floods. Those with the greatest number of flood rings grew on frequently flooded surfaces subject to flood-flow velocities of at least 1 m/s, and more typically greater than 2 m/s. Tree size, more than age, was related to flood-ring formation. Trees kept small by frequent flood damage had more flood rings than taller trees of comparable age. (USGS)
W85-06360

SURVIVAL ADAPTATIONS OF THREE EUPHOBIA SPP. IN ARID ECOSYSTEM,
Jodhpur Univ. (India). Dept. of Botany.
S. Kuman, and D. N. Sen.
Folia Geobotanica et Phytotaxonomica, Vol. 20, No. 1, p 57-66, 1985. 5 Fig, 1 Tab, 28 Ref.

Descriptors: *Weeds, *Arid lands, *Ecosystems, *Euphorbia, Plant growth, Stomata, Water deficit, Drought tolerance, Habitats, Plant water content, Transpiration.

The three species of Euphorbia (E. hirta, E. granulata, and E. prostrata) investigated are among the weeds adapted best to a dry environment. Water relations of these weeds have been compared with those of species well established in arid ecosystems such as Cyperus rotundus, Prosopis juliflora, P. cineraria and Calotropis procera. The three Euphorbia species showed survival adaptations in terms of the thickness of cuticle, number of hairs, leaf area, stomatal index, relative water content, water deficit, bound water, and plant water content. The thickness of cuticle and density of hairs increased from in-season to off-season while leaf area showed a sharp decrease. E. hirta had the highest relative water content (95%) while E. graulata was characterized by the lowest content (82%). Water deficit increased continuously from in-season to off-season. The plant water content was associated with the soil moisture content i.e., it decreased with depletion of soil moisture. The present study has further proved that plants tend to avoid harsh conditions by reducing their surface area, increasing their bound water content and by a low stomatal index, thick cuticle and by opening their stomata during hours of a low transpiration demand. (Baker-IVI)
W85-06371

INFLUENCE OF DIFFERENT LEVELS OF SOIL MOISTURE AS WELL AS OF NITROGEN AND POTASSIUM FERTILIZER ON THE YIELD AND QUALITY OF POTATOES IN MATURITY GROUP IV. SECOND REPORT: GROWTH, YIELD, AND YIELD COMPONENTS (DER EINFLUSS UNTERSCHIEDLICHER BODENFEUCHTESTUFEN SOWIE STICKSTOFF - UND KALIUMDUNGUNGSSTUFEN AUF ERTRAG UND QUALITAT VON KARTOFFELN DER REIFEGRUPPE IV),
Martin-Luther-Univ. Halle-Wittenberg, Halle (German D.R.).
H. Schmidt, and A. Vetter.
Wissenschaftliche Zeitschrift Martin-Luther-Universitat Halle-Wittenberg, Vol. 34, No. 1, p 50-60, 1985. 9 Fig, 2 Tab, 5 Ref.

Descriptors: *Soil water, *Nitrogen, *Potassium, *Fertilizers, *Plant growth, *Crop yield, *Potatoes, Plant physiology, Fertilization, Tubers, Crop production, Precipitation, Agronomy.

A study was performed in the German Democratic Republic in 1980 and 1981 of the influence of soil moisture and of nitrogen and potassium fertilizers on the growth and yield of potatoes in maturity group IV. Soil moisture during early growth was highly variable in both years, and this affected the length of the flowering period, having an alternating effect with initial soil moisture (ISM). The flowering period was shorter with 300 kg N fertilizer than with 150 kg. Increasing watering from the beginning of bud formation resulted in an increase in the number of stalks and length of shoots, while fertilizer variation did not affect this parameter. An increase in soil moisture between bud formation and the end of flowering caused speedier maturation of vegetation, while high final soil moisture (FSM) retarded maturation. Nitrogen fertilization also retarded maturation, while this effect was observed for potassium only in 1980. To achieve high yields, a soil-moisture content of 40% nFK was required between bud and flower when dry growth conditions prevailed between sprouting and bud formation, while 60% nFK was needed when soil moisture was high or average during early growth. An increase in soil moisture between the end of flowering and abscission level 70 (AL 70) unexpectedly caused a significant increase in yield. Raising nitrogen and potassium fertilization from 150 to 300 kg and from 240 to 480 kg, respectively, did not improve yield. Results of the study led to the following recommendations for soil moisture at the lower levels of fertilization: in order to achieve the highest possible yield for dry early-growth conditions, 40% nFK ISM, 80% nFK FSM; for wet early-growth conditions, 60% nFK ISM, 60% nFK FSM; 300 mm precipitation between bud formation and AL 70 (higher levels decrease yield). Highest yields were 406 dt/ha in 1980 (40/80% nFK) and 451 dt/ha in 1981 (60/80% nFK). Production of dehydrated potatoes, flour, and tubers corresponded to the yield of fresh potatoes. (Gish-IVI)
W85-06523

PLANT PHYSIOLOGICAL METHODS FOR STUDYING EVAPOTRANSPIRATION: PROBLEMS OF TELLING THE FOREST FROM THE TREES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2D.
W85-06674

WATER USE BY ISOLATED TREES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
For primary bibliographic entry see Field 2E.
W85-06677

PLANT COMMUNITIES AND GROUNDWATER LEVELS IN SOUTHERN NASSAU COUNTY, LONG ISLAND, NEW YORK,
City Coll., New York. Dept. of Biology.
For primary bibliographic entry see Field 2F.
W85-06802

EFFECTS OF SODIUM AND POTASSIUM CHLORIDES ON THE GROWTH AND ACCUMULATION OF MINERAL IONS BY CYPERUS INVOLUCRATUS ROTTB,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
For primary bibliographic entry see Field 5C.
W85-06803

INFLUENCE OF SOIL DROUGHT AND PARTIAL WATERLOGGING ON WATER RELATIONS OF GMELINA ARBOREA SEEDLINGS,
Department of Botany, University of Ibadan, Nigeria, Africa.
O. Osonubi, F. E. Fasehum, and I. O. Fasidi.
Oecologia, Vol. 66, No. 1, p 126-131, April, 1985. 6 Fig, 1 Tab, 14 Ref.

Descriptors: *Soil water, *Waterlogging, *Trees, *Gmelina, *Moisture stress, Transpiration, Plant growth, Plant physiology, Roots.

Stomatal conductance of unstressed, soil drought, and previously drought (predrought) Gmelina arborea seedlings increased in the morning and decreased before or immediately after midday. In the unstressed and predrought seedlings, leaf water potential decreased with increases in transpiration. In soil drought seedlings, there was some evidence of decreased hydraulic conductivity from soil to the plant, as indicated by the shape in the slope of the water potential/transpiration relationship. Root growth of drought plants was greater than in their unstressed counterparts at the lowest soil segment of a pot. The partial recovery of predrought seedlings was attributed to this substantial root growth in the lowest soil segment. In the second experiment, Gmelina arborea seedlings were partially waterlogged, by flooding the polyethylene bag to half its length, for a period of 23 days. Waterlogging induced stomatal closure and reduction in leaf water potential but there was some evidence of tolerance to waterlogging towards the end of treatment. Root growth, shoot and root dry weights were slightly reduced below those of controls. After 9 days of waterlogging, adventitious roots began to form which correlated with depletion of soluble sugars in the shoot but with an increase in the roots. It is suggested that the tolerance of Gmelina plants to either soil drought or waterlogging may partly be due to partitioning of the soluble sugars from shoot to roots for production of roots and formation of adventitious roots respectively which are likely to enhance the flow of water from the soils to the plant. Therefore the plant response is very similar under conditions of increased deficits and surplus of soil water. (Author's abstract)
W85-06858

DISTRIBUTION AND RELATIVE ABUNDANCE OF FISHES IN WISCONSIN: III. RED RIVER BASIN,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 2H.
W85-06909

EFFECTS OF PERMANENTLY RAISED WATER TABLES ON FOREST OVERSTORY VEGETATION IN THE VICINITY OF THE TENNESSEE-TOMBIGBEE WATERWAY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W85-06993

WATER STRESS CONDITIONING OF CORN (ZEA MAYS) IN THE FIELD AND THE GREENHOUSE,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
L. M. Dwyer, and D. W. Stewart.
Canadian Journal of Botany, Vol. 63, No. 4, p 704-710, April, 1985. 5 Fig, 1 Tab, 33 Ref.

Descriptors: *Corn, *Water stress, Leaves, Water potential, Osmotic potential, Plant conductivity, Turgor, Greenhouses, Field conditions.

Leaf water potential, osmotic potential, and leaf conductance were measured on corn (Zea mays L.) under water stress in the field and the greenhouse. Field-grown plants were subjected to several cycles of moderate water stress during vegetative growth, while greenhouse plants were well watered until just before the measurement period began following tasselling. In both the field and the greenhouse, leaf water potential declined at midday. Comparison of leaf water potential and osmotic potential measurements indicated that in both environments, the midday decline in leaf water potential was accompanied by a decline in osmotic potential. Since the decline in osmotic potential was greater than that accounted for by predicted volume changes resulting from normal daily dehydration, it was assumed to indicate osmotic adjustment. Despite these similarities, field-grown plants showed a greater response to water stress. Field plants underwent larger daily changes in leaf water potential and these were accompanied by larger changes in osmotic potential. As a result of this greater osmotic adjustment in the field, conductivity was higher at equivalent leaf water potentials and the critical leaf water potential was lower than in greenhouse-grown plants. In both environments, osmotic adjustment maintained leaf turgor (or pressure potential) in narrow positive range. Although there was no direct relation between turgor potential and leaf conductivity, it is hypothesized that the maintenance of a positive turgor potential during daylight hours is significant for growth since it may allow the moisture- and temperature-sensitive process of leaf expansion to proceed during the warmer daylight hours, even under moderate water stress. (Author's abstract)
W85-07140

2J. Erosion and Sedimentation

RELEASE OF PHOSPHORUS AND METALS FROM SOILS AND SEDIMENTS DURING DISPERSION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
A. Dong, G. V. Simsiman, and G. Chesters.
Soil Science, Vol. 139, No. 2, p 97-99, February, 1985. 1 Tab, 11 Ref. Great Lakes National Program grant R005142.

Descriptors: *Soil properties, *Bottom sediments, *Metals, *Phosphorus, *Dispersion, Menomonee River Basin, Wisconsin, Sediment transport, Resuspension, Lead, Zinc, Nickel, Manganese, Iron, Copper, Chromium, Cadmium, Aluminum.

Particle size distribution and chemical composition of each size fraction are important in characterizing soils and sediments. Ultrasound dispersion for size fractionation may release chemical constituents from the particles. Six soil types and 15 river bottom sediments from the Menomonee River Basin, Wisconsin, were sampled and analyzed for elemental composition. The P, Al, Cd, Cr, Cu, Fe, Mn, Ni Pb, and Zn released from soils and river bottom sediments to the supernatant liquid during dispersion by ultrasound and end-over-end shaking techniques were determined. The ratios of the elements in the supernatant to the total acid-digestible elements on the solid phase varied from 1.0 to 7.3% for soils and 0.3 to 2.0% for sediments, using ultrasound, and 0.05 to 2.6% for soils and 0.03 to 0.7% for sediments, using the sharing method. The ratio provides an estimate of the analytical error caused by dispersion during particle size fractionation. The ratio may indicate the extent of release of elements to the overlying water during resuspension or transport of sediments. Although the release of some elements was higher by the ultrasound treatment than by shaking for sediment samples, the t-test showed no significant difference between the two treatments, partly due to the small number of samples used in the shaking treatment. Because of the ease with which P and Cd are released to solution from river sediments, this phenomenon should be viewed with concern, knowing the importance of these contaminants in rivers and lakes. (Baker-IVI)
W85-06207

VARIABILITY IN MEASURED BEDLOAD-TRANSPORT RATES,
Geological Survey, Nashville, TN.
W. P. Carey.
Water Resources Bulletin, Vol. 21, No. 1, p 39-48, February, 1985. 12 Fig, 8 Ref.

Descriptors: *Bed load, *Sediment transport, *Variability, Flow discharge, Sampling, Probability.

Variability in bedload-transport rates during constant water discharge is an inherent part of the bedload-transport process. Although this variability has been measured extensively in the laboratory, similar information generally is not available from field measurements. During a four-day period of nearly constant water discharge, four sets of consecutively collected bedload samples, ranging from 43 to 120 samples, were obtained at the same cross channel location using a standard 65-pound Helley-Smith bedload sampler. When the measured transport rates are converted to dimensionless rates and plotted as cumulative frequency distributions, they show good agreement with a theoretical probability distribution function of rates derived for the case of ripples on dunes. The distributions show that during constant water discharge individual measured rates at a fixed point vary from near zero to four times the mean rate, and 60% of the sampled rates will be less than the mean. Because of the large variation in transport rates that occurs at every location in the cross section, many observations are required to establish an accurate estimate of the mean rate at any given location. (Author's abstract)
W85-06237

COMPARISON OF THREE METHODS FOR MEASURING RECENT RATES OF SEDIMENT ACCUMULATION,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
J. C. Ritchie, and J. R. McHenry.
Water Resources Bulletin, Vol. 21, No. 1, p 99-103, February, 1985. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Sediment accumulation rate, *Sedimentation, Backwater lakes, Lakes, Reservoirs, Sediment deposition, Cesium radioisotopes, Fallout, Spud method, Bottom contours.

The determination of sediment accumulation rates is important in understanding how these materials are affecting lakes and reservoirs ecosystems. In this study three methods were used to estimate sediment accumulation rates in the impounded backwater lakes behind Lock and Dam Nos. 8 and 9 on the upper Mississippi River. The three methods were: (1) a 'spud' survey, (2) a survey of bottom contours, and (3) the use of fallout cesium-137. The field use of these three methods of determining sediment accumulation and the potential errors and merits involved in each method are discussed. The results from the field study in backwater areas along the upper Mississippi River showed the survey of bottom contour method gave the lowest rate of sediment deposition and the Cs-137 method gave the highest rates. Sediment accumulation rates from 0 to 7.8 cm per year were measured in the study area. All three methods are useful and have unique characteristics for determining rates and patterns of sediment accumulation. Thus the choice of a method to be used in a sediment survey is dependent on the type of information needed and the time available. (Author's abstract)
W85-06244

SHOALING OF PORT OF ASTORIA, OREGON, BY SEDIMENT FROM MT. ST. HELENS ERUPTION,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
L. S. Slotta, C. R. Cobos, and R. S. Mustain.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 160661/AS, Price codes: A05 in paper copy, A01 in microfiche. Oregon Water Resources Research Institute, Corvallis, Project Completion Report, Publication WRRI-89, Corvallis, November 1983, 81 p, 30 Fig, 18 Tab, 30 Ref, Project No. BuRec C-10127-V (1), Contract/Grant No. 14-34-0001-1485(1).

Descriptors: *Sediment transport, *Sedimentation, *Suspended sediments, Silting, Shoals, Volcanoes, Estuaries, Harbors, *Oregon, *Mt. St. Helens, *Columbia River Estuary, Port of Astoria.

Sedimentation suddenly increased in the Lower Columbia River immediately following the May 18, 1980 eruption of Mt. St. Helens. Research

conducted at the Port of Astoria during 1981-1982 permitted determination of the shoaling mechanisms and confirmed that much of the deposited sediment was of recent Mt. St. Helens origin. Sedimentation rates slowly decreased after the eruption but were still higher than pre-eruption rates in early 1983. Circulation and shoaling characteristics at the Port were investigated through field work, a physical model, a numerical circulation model, and a numerical sedimentation model. The physical model provided insight to the overall circulation patterns and tidal exchange of water. The numerical circulation model gave additional information on residence times and flushing rates of water in the dock slips. The numerical sedimentation model gave estimates of sedimentation rates. Field research allowed a more quantitative investigation of shoaling conditions. Sediment deposition rates in the harbor slips were measured using sedimentation buckets. Water currents and circulation were measured. Water samples were collected to characterize suspended sediment concentrations. Core samples of bed material were obtained for various physical analyses. Well-graded silt was the typical suspended sediment and bed material. Clay mineralogy, heavy minerals and microprobe tests indicated that the Columbus River (rather than nearby Youngs Bay) is the primary source of the suspended sediment causing chronic shoaling at the Port and that the Mt. St. Helens eruption contributed to that shoaling.
W85-06302

EVOLUTION OF A DRAINAGE NETWORK: REMOTE SENSING ANALYSIS OF THE NORTH FORK TOUTLE RIVER, MOUNT ST. HELENS, WASHINGTON,
Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W85-06303

CHANNEL CHANGE WORKSHOP PROBLEM NUMBER 3, ELK RIVER, KANSAS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 6G.
W85-06354

MICROSYSTEM SEDIMENT-WATER SIMULATION: A PRACTICAL TECHNIQUE FOR PREDICTING RESERVOIR WATER QUALITY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5B.
W85-06358

MASS MOVEMENT AND EROSION OF A SOUTHERN PENNINE BLANKET PEAT,
Victoria Univ. of Manchester (England). School of Biological Sciences.
J. H. Tallis.
Journal of Ecology, Vol. 73, No. 1, p 283-315, March, 1985. 13 Fig, 7 Tab, 40 Ref.

Descriptors: *Erosion, *Peat bogs, *Featherbed Moss, *England, Pollen analysis, Dating, Degradation, Mass wasting, Soil properties, Air pollution.

Pollen and macrofossil analyses were carried out at nineteen sites within a 1 sq km area of Featherbed Moss, Derbyshire, England. The sites covered a range of uneroded and eroded blanket peat types. Peat accumulation varied considerably, both within and between sites, from about 6 to 96 g/sq m/yr. The most striking differences occurred in the time interval 400-1000 A.D., when some sites showed an increased rate of peat accumulation and others a decreased rate. Two features of the growth of the peat blanket on Featherbed Moss are suggested to have been of major importance in ultimately bringing about its degradation and erosion: a very early spread of peat over flatter ground to the limits imposed by topography; and a rapid buildup of largely unhumified Sphagnum peat over more consolidated peat after 400 A.D. The onset of peat erosion on Featherbed Moss 1000-1200 years ago is interpreted as a natural phenomenon, instituted by a series of bog slides and bursts around the margin of the peat blanket. These led to the formation of drainage gullies extending back into the peat, slumping of the marginal peat downslope, and drawing off of water from the pools of the hummock-hollow complex on the watershed. The death of Sphagnum from air pollution some 200-300 years ago led to renewed peat erosion, which is still in progress. (Baker-IVI)
W85-06368

SOME PROBLEMS ABOUT THE SOIL EROSION IN THE VRANCEA SUBCARPATHIANS (QUELQUES PROBLEMES SUR L'EROSION DES SOLS DANS LES SUBCARPATES DE VRANCEA),
R. Gaspar, E. Untaru, C. C. Cristescu, and F. Roman.
Revue Roumaine Geologie Geophysique et Geographie, Vol. 28, p 67-72, 1984. 2 Fig, 3 Tab.

Descriptors: *Soil erosion, *Catchment areas, Runoff, Floods, Soil properties, Sediment transport, Erosion control, Mathematical equations.

There are presented the research works carried out during a period of 8-10 years in five torrential catchments with areas between 154 and 713 ha, covered by forests in a percentage of 16 to 98%. The maximum runoff coefficients during a high flood were between 0.342 (in the case of the catchment with a sandy-loamy soil) and 0.642 (in the case of the catchment with loamy-clayish soils). The specific erosion varied between 0.03 and 0.53 kWh/year. The channels and the afferent banks contributed with 88-95% of the total sediment transport, the rest was due to the slopes. Forests are an excellent means for maximum discharge diminishing and slope erosion controlling. The soil humidity in the first 20 cm was expressed with respect to the rainfall storm (h) and the antecedent precipitation index (IPA) in regression equations. The highflood waterloading with alluvial materials (Y)-in suspension-was expressed with respect to the flood discharge (X) in regression equations. (Author's abstract)
W85-06420

BANK SEDIMENT TYPE AND SUSPENDED-SEDIMENT TRANSPORT IN SAND-BED STREAMS,
Delaware Univ., Newark. Dept. of Geology.
J. E. Pizzuto.
Journal of Sedimentary Petrology, Vol 55, No. 2, p 222-225, March, 1985. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Sediment transport, *Suspended sediments, Sand, Stream banks, Streams, Clay, Silt.

The percent silt-clay in the banks of 12 sand-bed streams is significantly correlated with the percent of sand carried in suspension. A parameter which explicitly represents the rate of deposition for each grain size provides an even better correlation between the grain sizes in transport and those exposed in the banks. These results, though necessarily limited by the small number of rivers studied, provide a quantitative link between the sediment transport regime of a stream and its sedimentary record. (Authr's abstract)
W85-06421

DIFFERENTIAL TRANSPORT OF FALL-EQUIVALENT SAND GRAINS, LAKE ONTARIO, NEW YORK,
Illinois State Geological Survey Div., Champaign.
C. B. Trask, and B. M. Hand.
Journal of Sedimentary Petrology, Vol. 55, No. 2, p 226-234, March, 1985. 7 Fig, 36 Ref.

Descriptors: *Sediment transport, *Lake Ontario, *New York, Entrainment, Minerals.

Fractions composed of grains having uniform fall velocity were extracted from beach sands collected along the eastern end of Lake Ontario, New York. Heavy-liquid separations and point counts were performed on these fall-equivalent velocity splits to obtain relative abundances of hornblende, augite, hypersthene, garnet, magnetite, and quartz-density lights. Heavy minerals decrease in abundance in the direction of transport, and the degree to which any particular mineral lags behind another lighter mineral is a simple function of the mineral's effective-density ratio. The results confirm that heavy minerals are less transportable than fall-equivalent lights, an effect that may result from differential entrainability, transport within different zones of the beach, or both. (Author's abstract) 35 073187000
W85-06422

SUSPENDED LOAD OF THE DANUBE IN THE DANUBE-DNIEPER WATER SUPPLY SYSTEM (VZVESHENNYE NANOSY DUNAYA V SISTEME VODOKHOSYAISTVENNOGO KOMPLEKSA DUNAI-DNEPR),
V. M. Timchenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 4, p 73-85, 1984. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Suspended load, *Danube River, Suspended sediments, Sediment transport, Sedimentation, Water quality, Weather, Hydrology.

Conditions of influx, transport and accumulation of suspended load of the Danube river in the system of the designed Danube-Dnieper water supply system are studied as an important factor of water quality formation. A characteristic of potential volumes of the Danube suspended loads transported and accumulated in certain areas of the system is made on the basis of data on hydrometeorological conditions and parameters of certain elements of the system with extensive use of modern apparatus for calculating sedimentation processes. (Author's abstract)
W85-06479

INTENSITY OF DENITRIFICATION IN THE RYBINSK RESERVOIR GROUNDS (INTENSIVNOST' DEMITRIFIKATSII V GRUNTAKH RYBINSKOGO VODOKHRANILISHCHA),
I. N. Krylova.
Gidrobiologischeski Zhurnal, Vol. 20, No. 5, p 35-41, 1984. 1 Fig, 4 Tab, 18 Ref.

Descriptors: *Denitrification, *Rybinsk Reservoir, *Watersheds, Nitrates, Seasonal variation, Bottom sediments, Soil chemistry, Microorganisms, Nitrogen.

The acetylene inhibition method was used to determine intensity of biologic denitrification in the Rybinsk reservoir watershed for the vegetation period of 1979. It is shown that the process of nitrate reduction of molecular nitrogen is observed in all the seasons with an autumn maximum found, irrespective of the soil character. It is established that high content of nitrates in the watershed is the basic factor which determines denitrification activity in the bottom sediments of the Rybinsk reservoir under favorable redox conditions. Microflora is found to possess a high potential ability for denitrification. The mean denitrification intensity for the navigation period (163 days) was 3.1 mg N/sq m/day and total nitrogen losses for this time were 2327 t. (Author's abstract)
W85-06481

EVALUATION OF THE CONSUMED ORGANIC SUBSTANCE STOCK AND INTENSITY OF ITS DESTRUCTION IN THE KILIAN DELTA OF THE DANUBE (OTSENKA ZAPASA USVOYAEMOGO ORGANICHESKOGO VESHCHESTVA I INTENSIVNOSTI EGO DESTRUKTSII V VODE KILIISKOI DEL'TY DUNAYA),
I. K. Bashmakova.
Gidrobiologischeski Zhurnal, Vol. 20, No. 5, p 72-78, 1984. 2 Fig, 3 Tab, 22 Ref.

Descriptors: *Organic matter, *Decomposition, *Kilian Delta, *Danube, *USSR, Fate of pollutants, Deltas.

Organic substance destruction processes in the Soviet area of the Danube are quantitatively estimated. The stock both of organic substance on the whole and its biochemically mobile part is determined and the rate of the self-purification process-

es proceeding in the Kilian delta arms of the Danube is established. (Author's abstract)
W85-06482

MODELING SEDIMENT DETENTION PONDS USING REACTOR THEORY AND ADVECTION-DIFFUSION CONCEPTS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
B. N. Wilson, and B. J. Barfield.
Water Resources Research, Vol. 21, No. 4, p 523-532, April, 1985. 5 Fig, 4 Tab, 20 Ref.

Descriptors: *Detention reservoirs, *Sedimentation, *Reactor theory, *Advection, *Diffusion, Algorithms, Mathematical models, Residence time, Particulate matter, Mass balance.

An algorithm called BASIN was developed to model the sedimentation process in detention ponds. This model was based on a mass balance equation (derived for an infinitesimal layer) that coupled reactor theory concepts with advection-diffusion processes. Reactor theory concepts are used to determine residence time of sediment particles and to mix influent sediment with previously stored flow. Advection-diffusion processes are used to model the settling characteristics of sediment and the vertical diffusion of sediment due to turbulence. The governing differential equation was solved for a maximum of nine different particle size classes to account for the large variation in settling characteristics of a nonuniform distribution. The concentrations from individual particle classes were then combined linearly to obtain a composite effluent concentration. Numerical solutions were obtained by using an implicit finite difference scheme. Predicted results of the model are compared to those observed on two pilot scale ponds for a total of 12 runs. The average percent error between predicted and observed trap efficiency was 5.2 %. The pond model did an excellent job of predicting the shape of the effluent sedimentgraphs. Relative to the peak influent concentration, the peak effluent concentration was predicted with reasonable accuracy. (Moore-IVI)
W85-06506

RESPONSE OF ALLUVIAL RIVERS TO SLOW ACTIVE TECTONIC MOVEMENT,
Chuo Univ., Tokyo (Japan). Inst. of Geosciences.
S. Ouchi.
Geological Society of America Bulletin, Vol. 96, No. 4, p 504-515, April, 1985. 15 Fig, 1 Tab, 37 Ref. NSF project EAR-7727573.

Descriptors: *Alluvial rivers, *Tectonic movement, *Channel morphology, Braided channels, Subsidence, Uplift, Bank erosion, Aggradation, Slopes, Sinuosity, Surface deformation.

Alluvial rivers respond to valley-slope deformation caused by active tectonics in various ways depending on the rate and amount of surficial deformation and on the type of river. On the basis of experimental results and field examples, hypothetical models of river response to anticlinal uplift and synclinal subsidence were developed for different types of alluvial rivers. An experimental braided channel responded to anticlinal uplift across the channel with degradation and terrace formation in the central part of the uplift. With subsidence, aggradation in the central reach was the main response. Transverse bars developed downstream of the subsidence axis. An experimental meandering channel responded to slope steepening with a sinuosity increase. Bank erosion and point-bar growth occurred downstream of the anticlinal axis and upstream of the synclinal axis. Upstream of the uplift axis and downstream of the subsidence axis, where the slope was flattened, water flooded over bars. Local convexity in longitudinal profiles of the middle Rio Grande, New Mexico, is considered to be formed by a domal uplift. Local aggradation and degradation could be explained by the effect of uplift. The San Joaquin River, California, which is now highly controlled, does not show clear adjustment to the rapid subsidence due to groundwater withdrawal. It shows, however, a channel-pattern adjustment to active tectonic subsidence that has been occurring for a long time. The San Antonio and Guadalupe Rivers in Texas both increase their sinuosity significantly where monoclinal movements steepen valley slopes. (Author's abstract)
W85-06517

DRAINAGE INITIATION BY SUBSURFACE FLOW IN SOUTH TARANAKI, NEW ZEALAND,
Victoria Univ., Wellington (New Zealand). Dept. of Geology.
For primary bibliographic entry see Field 2E.
W85-06520

SUSPENDED-SOLIDS LOAD OF THE TRIBUTARIES OF THE SUSSEN SEE (DIE SCHWEBSTOFFBELASTUNG DER ZUFLUSSE ZUM SUSSEN SEE),
Martin-Luther-Univ. Halle-Wittenberg, Halle (German D.R.). Sektion Geographie.
M. Thomas.
Wissenschaftliche Zeitschrift Martin-Luther-Universitat Halle-Wittenberg, Vol. 34, No. 1, p 72-94, 1985. 11 Fig, 3 Tab, 8 Ref.

Descriptors: *Suspended solids, *Sediment load, *Sussen See, *Germany (Democratic Republic), *Tributaries, Water level, Sediments, Precipitation, Lakes, Rivers.

The quantity of suspended solids (SS) was measured at three sites on tributaries to the Susser See, a lake near Halle in the German Democratic Republic, between July 1979 and September 1982. In general, SS load decreased during the measuring period. Values varied within a distinct range, but there were also occasional peak values that exceeded the range by far. At two sites (on the Bose Sieben river at Wimmelburg, W, and Unterrissdorf, U), water level was also measured; this showed that water and SS levels did not always correspond. Arithmetic means for SS levels measured were: 85.6 mg/l at W, 99.9 mg/l at U (which is downstream from W), and 68.5 mg/l at Eisleben (E) on the Wilder Graben. Annual mean values decreased steadily: for W, E, and U, respectively, they were (in mg/l) 122.1, 109.0, and 154.5 in 1979 and 33.5, 34.0, and 42.6 in 1982. Peak values (> 50-75% over the median) occurred most often at E, with highest levels at W; e.g., there was a high of 14 occurrences at E in 1980, a low of 4 at U in 1979; highest levels were 370-4, 660 mg/l for the 1980 mean at W, lowest were 135-810 mg/l for the 1982 mean at U. The data showed that close positive correlations could exist between precipitation, river water level, and SS load, but also that these factors could be negatively correlated. Heavy or long-lasting rainfall was the most common cause of increased SS load and water levels. Cases of increased SS with no preceding rainfall and constant or only slightly increasing water level occurred usually at only one measuring site and were attributed in part to bank collapse and, more likely, to influxes of polluted wastewater. At E and U, higher monthly means in SS content occurred in November, December, and January than at W, and were heavily dependent on weather conditions; at W, maximum levels tended to occur in summer, especially in July. These differences are attributed to geological site and temperature variation. (Gish-IVI)
W85-06524

RECENT SEDIMENTATION RATES AND 210PB FLUXES IN GEORGIAN BAY AND LAKE HURON,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
S. R. Joshi.
Science of the Total Environment, Vol. 41, No. 3, p 219-233, March, 1985. 4 Fig, 3 Tab, 47 Ref.

Descriptors: *Sedimentation, *Lake Huron, *Georgian Bay, *Lead radioisotopes, Cesium radioisotopes, Great Lakes, Radionuclides, Sediment transport, Lake sediments.

In 1974 sedimentation rates were measured in four depositional basins of Lake Huron from Pb-210 profiles. A fifth core, collected at station 5, was disturbed during transportation. In order to assign Pb-210 dates to all major sedimentary regions of Lake Huron and Georgian Bay, sediment cores from remaining zones, including station 5, were obtained and analyzed in 1980. The measured fluxes of Pb-210 at the sediment/water interface are discussed in relation to the inputs of atmospheric Pb-210 to the Great Lakes region. The Cs-137 profiles in these sediment cores are also assessed. Except for one location, the rates show marginal to good agreement with those estimated from palynological measurements at four of the five study locations. Cs-137 profiles at study locations suggest that the top portions of the sediment cores were satisfactorily retrieved during coring and sectioning operations. Considerable downward migration of Cs-137 is noted at three locations. The fluxes of excess Pb-210 vary between 0.06 and 0.27 pCi/sq cm/yr. The average depositional flux is considerably lower than the flux of atmospheric Pb-210. The deposition of atmospheric Pb-210 in Lake Huron and Georgian Bay sediments may be limited by the supply of scavenging particulates. (Baker-IVI)
W85-06547

SIMULATION OF CHANNEL STEEPENING IN THE MARALA-RAVI LINK CANAL,
Irrigation Dept., Lampang (Thailand).
K. V. H. Smith, and S. Kaewyen.
Proceedings of the Institution of Civil Engineers, Vol. 79, Part 2, p 203-209, March, 1985. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Marala-Ravi Link Canal, *Pakistan, *Channel morphology, *Channel erosion, *Channels, *Sediment transport, Sedimentation, Flow, Water diversion, Sediment erosion, Computer models, Flow discharge.

The Marala-Ravi Link Canal was constructed in Pakistan to convey water between different tributaries of the River Indus in order to make up water deficiencies resulting from diversions elsewhere. Because of its large designed discharge capacity, it was included in an observation program which monitored discharges, sediment transport, some bed elevations and so on. By using a computer program set up to model flow resistance and sediment transport in sand-bed canals, the steepening of the canal bed during the first years of use was satisfactorily simulated. The numerical technique has reproduced fairly well the behavior of the Marala-Ravi Link Canal. Once sediment deposition had raised the channel bed by about a meter near the headworks, the reduced channel cross section made it impossible to carry the intended discharge of about 623 cu m/sec. Had the same canal been required to convey its maximum discharge capacity on a continuous basis, rather than intermittently, the original cross-section and slope would probably have remained stable. (Baker-IVI)
W85-06580

SEDIMENTATION AND SEDIMENT ANALYSIS IN MUGGEL LAKE (SEDIMENTATION UND SEDIMENTANALYTIK IM MUGGELSEE),
Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
For primary bibliographic entry see Field 2H.
W85-06653

RELATIONSHIP OF WATER VOLUME AND WATER QUALITY PARAMETERS (ZUM ZUSAMMENHANG VON PARAMETERN DER WASSERMENGEN UND WASSERBESCHAFFENHEIT),
Forschungszentrum fuer Wassertechnik, Dresden (German D.R.).
For primary bibliographic entry see Field 5B.
W85-06662

SEASONAL SUCCESSION AND MICROLAMINA FORMATION IN A MEROMICTIC LAKE DISPLAYING VARVED SEDIMENTS,
Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
M. Dickman.
Sedimentology, Vol. 32, No. 1, p 109-118, Febru-

ary, 1985. 11 Fig, 3 Tab, 29 Ref.

Descriptors: *Lake sediments, *Seasonal variation, *Succession, *Meromictic lakes, *Toronto, *Ontario, *Varved sediments, *Microlamina, Anaerobic conditions, Sediments, Bacteria, Profundal waters, Phytoplankton, Organic matter, Stratification, Sulfur, Sulfides, Calcite.

In a small meromictic lake near Toronto, Canada, a mass mortality of photosynthetic bacteria followed the ventilation of the chemocline during fall (autumn) and resulted in 3.8 g/sq m/day of organic matter being deposited as a dark layer in sediment traps which were suspended in the permanently anaerobic zone. This mass mortality of photosynthetic bacteria occurred in late autumn following the annual thermal destratification of the lake's mixolimnion. Wind mixing during this period of homeothermy resulted in the introduction of low levels of dissolved oxygen into the lake's chemocline. The ensuing mass mortality of photosynthetic bacteria resulted in the release of elemental sulfur as the sulfur-rich bacteria decomposed and sank to the bottom of the lake. The ferrous ions in the water below a depth of 15 m in Crawford Lake reacted with this sulfur to form black ferrous sulfides and pyrite which formed a dark microlamina on the lake floor. Each dark microlamina was overlain by a light colored (calcite-rich) layer which was deposited each spring and summer during the 3 yr period of this study. The mechanism of microlamina formation elucidated here has been based on the examination of biweekly sediment trap information. This approach has permitted an explanation of the mechanisms by which specific events such as calcite precipitation and phytoplankton seasonal succession are transcribed into the sediment record. (Author's abstract)
W85-06699

210PB-DERIVED SEDIMENT ACCUMULATION AND MIXING RATES FOR THE GREATER PUGET SOUND REGION,
Washington Univ., Seattle. School of Oceanography.
R. Carpenter, M. L. Peterson, and J. T. Bennett.
Marine Geology, Vol. 64, No. 3/4, p 291-312, April, 1985. 4 Fig, 3 Tab, 38 Ref.

Descriptors: *Sediments, *Puget Sound, *Lead radioisotopes, *Mixing, Isotope studies, Sediment mixing, Geochemistry, Coastal waters.

Recent sediment accumulation rates of 46-1200 mg/sq cm/yr are calculated from excess Pb-210 activity profiles in 44 sediment cores from 27 sites in the greater Puget Sound region. Rates calculated for nine stations in the deeper waters of central Puget Sound average 480 mg/sq cm/yr and are greatest between Seattle and Tacoma near the southern end of this region. The standard error of this mean is + or - 113 mg/sq cm/yr. Magnitudes and geographic trends of Pb-210 derived accumulation rates agree with limited data on sediment inputs and transport paths. Their accuracy is further supported by several independent approaches, including comparison with particle fluxes collected in year-long series of sediment trap deployments at two sites. Accumulation rates are calculated assuming no mixing beneath surface mixed layers of 2-22 cm. Sediment mixing coefficients in these surface layers average at least 43 sq cm/yr, four times greater than those reported in open Washington coast sediments. The difference is attributed to the greater benthic biomass in Puget Sound sediments. Particle residence times in surface mixed layers vary from 1.5 to 68 years and introduce corresponding uncertainties in ages of horizons beneath the mixed layers. For most of this region, these residence times will cause a 20-30 year time lag in achieving an equivalent response of surface sediment chemical concentrations to changes in concentrations in freshly depositing particles, for constituents whose stability and phase associations resemble those of Pb-210. These time lags limit the ability of sediment chemistry monitoring programs to recognize recent changes in composition and fluxes of chemicals to sediments. Recent fluxes calculated from the product of surface sediment chemical concentration and accumulation rates will be inaccurate for chemicals if their input concentrations have changed in the last 20-30 years. (Author's abstract)
W85-06701

TRANSFORMATION OF THE OB RIVER CHANNEL DOWNSTREAM OF THE NOVOSIBIRSK HYDROELECTRIC STATION,
For primary bibliographic entry see Field 6G.
W85-06710

WATER QUALITY FROM EROSION CONTROL STRUCTURES IN NEBRASKA,
Nebraska Univ.-Lincoln.
J. S. Schepers, D. D. Francis, and L. N. Mielke.
Journal of Environmental Quality, Vol. 14, No. 2, p 186-190, April/June, 1985. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Water quality, *Erosion control, *Nebraska, Sedimentation basins, Model studies, Terracing, Best management practices, Nutrients, Nitrogen, Phosphorus, Rainfall, Water pollution control.

Runoff collected from terrace and sediment-control basins having tile-outlet systems was compared with runoff water quality from Maple Creek in northeastern Nebraska. This study was part of a Model Implementation Project (MIP) initiated in 1978 to accelerate land treatment for erosion control and development of best management practices (BMPs). Soils in the area are very erosive (Nora-Crofton complex) when subjected to high-intensity rainfall in the spring and summer. Sediment concentrations in runoff from the terraces and sediment basins were initially high and comparable to stream concentrations until a pool of runoff water formed around the riser inlet of the tile discharge system. Formation of a pool allowed sediment to settle out away from the riser inlet, thus reducing sediment losses from the field. Sediment-born N and P accounted for 85 to 98% of total N and P losses from the land. Because tile-outlet terraces and sediment basins effectively reduced sediment and nutrient concentrations in runoff, they proved to be an effective BMP for use by producers. (Author's abstract)
W85-06716

SEDIMENTOLOGY AND EVOLUTION OF OHIWA HARBOUR, A BARRIER-IMPOUNDED ESTUARINE LAGOON IN BAY OF PLENTY,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2L.
W85-06798

ROLE OF GROUND FROST, SNOW COVER, ICE BREAK-UP AND FLOODING IN THE FLUVIAL PROCESSES OF THE OULANKA RIVER, NE FINLAND,
Oulu Univ. (Finland). Dept. of Geology.
L. Koutaniemi.
Fennia, Vol. 162, No. 2, p 127-161, 1984. 25 Fig, 5 Tab, 78 Ref.

Descriptors: *Frost, *Snow cover, *Ice breakup, *Flooding, *Oulanka River, *Finland, Seasonal variation, Channel morphology, Meanders, Stream banks, Erosion, Deposition, Bank erosion.

The significance of ground frost in the river banks, the winter snow cover, the ice break-up and the spring high water levels in shaping the relief of the meandering section of the Oulanka river was assessed. Field studies covering a 7-year period were carried out on two migrating meanders in an area where the river is constantly re-arranging its former terraces, which are rich in sand horizons. The importance of the snow and ground frost period manifested itself in two ways. Firstly, this 'rest season' appeared to be highly critical for gathering the discharge reserve which is then released at the spring high water season, which accounts for a half of the total annual discharge and initiates major changes in the river channel. Secondly, the freezing of the banks, frequently reaching over a meter in depth, did not as such exercise any direct effect on the activity of fluvial processes but was certainly found to control the process of material erosion in a pattern referred to as the two-cycle bank retreat. On the whole the ice drive appeared to be minor significance, but this may merely be due to the obscuring effects of later higher water levels. Fluvial processes bore evidence of 'erosion' and 'deposition' years. The higher the bank erosion, the lower the point bar net budget. This is shown to be due to the fact bank erosion increases in linear manner with the severity of the spring floods, whereas the net budget of depositional environments. i.e. the relationship between degradation and aggradation, tends to decline with an increase in flood height. Intensive bank erosion appeared to be associated with pronounced scouring of the point bars and vice versa. This in turn implies that annual fluctuations in the equilibrium of the river take place between the two poles of erosion and accumulation. At least on the basis of short-term trends in the meander behavior of the river, these two factors have been in a state of quasi-equilibrium with erosion dominant. (Collier-IVI)
W85-06806

PRESENT TIME REGIME OF SEDIMENT DISCHARGE IN THE MOUTH REGION OF THE RIVER OB (SOVREMENNYI REZHIM STOKA NANOSOV V UST'EVOI OBLASTI R. OBI),
K. V. Rasumikhina.
Vestnik Leningradskogo Universiteta Geologiia-Geografiia, Vol. 24, p 65-73, 1984. 3 Tab, 14 Ref.

Descriptors: *Sediment discharge, *River mouth, *River Ob, *USSR, Deltas, Particle size, Sandbars, Annual distribution.

The main regularities of sediment discharge regime and grain size distribution in the mouth region of the River Ob are considered. Information on annual variability of sediment discharge for many years in the main water courses of the delta was obtained. An approximate estimation of the direction and the intensity of sediment transfer on the Yamsalski bar is given. (Author's abstract)
W85-06807

EFFECT OF TILT ON SEDIMENT TRAP EFFICIENCY,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 7B.
W85-06850

WIND-RELATED RESUSPENSION OF SEDIMENTS IN THE PEEL-HARVEY ESTUARINE SYSTEM,
Western Australia Univ., Nedlands. Dept. of Soil Science and Plant Nutrition.
For primary bibliographic entry see Field 2L.
W85-06851

SEDIMENTATION AND SEDIMENT RESUSPENSION IN LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
F. Rosa.
Journal of Great Lakes Research, Vol. 11, No. 1, p 13-25, 1985. 9 Fig, 2 Tab, 30 Ref.

Descriptors: *Lake Ontario, *Sedimentation, *Resuspension, *Stratification, *Great Lakes, Trap efficiency, Turnover time, Thermal stratification, Epilimnion, Fate of pollutants.

From March to November 1981, seasonal variations in the weekly sedimentation rates of particulate matter were investigated at an inshore and at an offshore site in Lake Ontario. Sedimentation rates at both sites showed extremely high variability from week to week; minimum to maximum rates varied by a factor of 10 for the offshore site and by a factor of 40 for the inshore site. The variability in the offshore rates was mainly due to the amount of particulate matter in the epilimnion, and in the inshore rates was mainly due to bottom sediment resuspension. Offshore sedimentation rates of total suspended matter measured in the thermocline were a function of the total suspended matter

concentrations in the epilimnion. Sedimentation rates measured in the thermocline were higher than those measured at the top of the hypolimnion showing particulate matter retention in the thermocline. Sedimentation rates measured at 5 meters above the bottom at both stations were extremely variable with time and the inshore rates at times exceeded the offshore rates by a factor of 50. This major difference was observed during fall turnover, when previously sedimented material and associated contaminants were resuspended at the inshore site. Since the net downward flux is a function of epilimnetic concentrations, it is clear that inshore resuspension occurs continuously but at varying intensities. (Author's abstract)
W85-06861

MODEL-PROTOTYPE COMPARISON STUDY OF DIKE SYSTEMS, MISSISSIPPI RIVER: POTAMOLOGY INVESTIGATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W85-06892

GEOLOGICAL CHARACTER AND MINERAL RESOURCES OF SOUTH CENTRAL LAKE ERIE,
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 2H.
W85-06907

LONGSHORE SAND TRANSPORT STUDY AT CHANNEL ISLANDS HARBOR, CALIFORNIA,
Coastal Engineering Research Center, Fort Belvoir, VA.
R. O. Bruno, R. G. Dean, C. G. Gable, and T. L. Walton.
Technical Paper No. 81-2, April 1981. 48 p, 18 Fig, 5 Tab, 23 Ref, 2 Append. Project No. F31232.

Descriptors: *Sediment transport, *Hydraulics, *Waves, *Breakwaters, *Protection, Littoral zone, Sand, Shore protection, Dredging, Channel Islands, California, Coastal engineering.

A field experiment was conducted to develop correlations between wave characteristics and longshore sediment transport. The waves were measured by two near-bottom mounted pressure transducers and by visual observation when pressure transducers were not in operation. The average longshore sediment transport rates were determined from sequential volumetric surveys behind an offshore breakwater which was regarded as a total trap. The data analyzed encompass a period of 2 years, 1 year after each dredging cycle. Spectral analysis of the pressure gage wave data were conducted and yielded one direction per frequency. The correlations include immersed weight sediment transport rate, I, versus longshore component of wave energy flux at breaking, Pls. The most widely used correlation constant, K, in the relationship I = k times Pls is 0.77. The value determined from the data was K = 0.98, based on the Pls values directed toward the trap. One feature of this type of trap is the potential for overtrapping if the waves are directed nearly normal to shore. (Author)
W85-06918

EROSION CONTROL OF SCOUR DURING CONSTRUCTION; REPORT 5: EXPERIMENTAL MEASUREMENTS OF REFRACTION AND DIFFRACTION DOWNCOAST OF AN OBLIQUE BREAKWATER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W85-06920

SOUTH FORK TILLATOBA CREEK DROP STRUCTURE, MISSISSIPPI: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W85-06923

STUDY OF CUTOFF BENDWAYS ON THE TOMBIGBEE RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W85-06928

METHOD TO FORECAST SEDIMENTATION RATES RESULTING FROM THE SETTLEMENT OF SUSPENDED SOLIDS WITHIN SEMIENCLOSED HARBORS,
Coastal Engineering Research Center, Fort Belvoir, VA.
C. H. Everts.
Coastal Engineering Technical Aid No. 81-6, June 1981. 19 p, 7 Fig, 1 Tab, 6 Ref. Project No. D31235.

Descriptors: *Sedimentation rates, *Harbors, *Coastal engineering, Model studies, *Mathematical models, Tides, Suspended sediment, Dillingham Harbor, Alaska, Rivers, Navigation, Water currents, Bed load, Forecasting, Shoals.

A method is given for estimating the sedimentation rate in a semienclosed harbor before construction. It can be applied to situations where the harbor is almost totally enclosed; bedload transport is negligible; deposition is nearly uniform throughout the harbor; sediment will not be resuspended after deposition; and tide or river stage rise causes currents which move water and suspended sediment into the harbor. A sample problem is solved for Dillingham Harbor, Alaska, which is an enclosed half-tide harbor requiring almost continuous dredging during the summer months. Results of the mathematical model were about 10%-15% less than measured results. Settling velocity distribution was a crucial factor.
W85-06929

SUMMARY REPORT: MODEL-PROTOTYPE COMPARISON STUDY OF DIKE SYSTEMS, MISSISSIPPI RIVER; POTAMOLOGY INVESTIGATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W85-06962

EROSION ON VERY STONY FOREST SOIL DURING PHENOMENAL RAIN IN WEBSTER COUNTY, WEST VIRGINIA,
Northeastern Forest Experiment Station, Broomall, PA.
J. H. Patric, and W. E. Kidd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-128140. Research Paper NE-501, 1982. 13 p, 11 Fig, 23 Ref.

Descriptors: *Soil erosion, *Washouts, *Weathering, *Erosion control, *Roads, *Sediment load, *Logging, *Stream degradation, Rockslides, Forest soils, Road construction, Paving, Detritus, Forest management, Sediment transport, Soil management, Soil conservation, Soil stabilization.

On July 15 and 16, 1979, at least 6 inches of rain fell in central West Virginia during a 3 hr period. Six miles of logging roads were examined for soil erosion and sediment delivery to streams. Erosion as negligible on very stony soils where logging roads were litter covered, road grades were < 15%, and volumes of overland flow on logging roads had been small. The average rate of erosion from logging roads was about 5 tons/acre of logged over land. Severest erosion ranged from 0.6 to 0.8 ton of soil and rock per ft of road. Approximately two-thirds of the detritus from the most severely eroded road was thought to reach a nearby river and contribute to its sediment load, but only about one-third of the detritus reached the river from less severely eroded roads. Construction of an erosion pavement on most of the roads prevented greater soil loss. These studies suggest that with proper location and management of logging roads, erosion on very stony soils may be held to little in excess of geologic rates.
W85-06967

ENGINEERING GEOLOGY AND GEOMORPHOLOGY OF STREAMBANK EROSION; REPORT 2: YAZOO RIVER BASIN UPLANDS, MISSISSIPPI,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
C. B. Whitten, and D. M. Patrick.
Technical Report GL-79-7, October 1981. Report 2 of a Series. 197 p, 94 Fig, 11 Tab, 33 Ref.

Descriptors: *Stream degradation, *Stream erosion, *Bank erosion, *Channel erosion, *Channeling, *Sediment discharge, *Dam effects, *Land use, Slope degradation, Stream discharge, Streamflow, River basins, Streams, Erosion control.

Four streams of the hill region of the Yazoo River exhibiting excessive streambank erosion were examined by chronological sequences of aerial photographs, field observations, maps and surveys to detect events that affected the hydraulic and geomorphic conditions. Results showed that land use practices in the Delta from the 1800's to the present increased flow and sediment discharge. In the uplands, land use practices during the 1800's and early 1900's also increased flow and sediment discharge. Channelization during the early 1900's increased channel slopes. Meander cutoffs made on the Mississippi, Yazoo, Tallhatchie, and Coldwater Rivers from 1921 to 1953 increased channel slopes. In the late 1930's, conservation practices decreased flow and sediment discharge in the uplands. Dam construction on the four streams in the 1940's and 1950's coupled with channelization below the dams increased stream degradation by increasing channel slope and the release of sediment-free water below the dam. Continued channelization since the 1940's has increased channel slopes. Channelization is cited as the main factor in streambed and streambank erosion. Channel degradation believed to be caused by the increased gradient and the other mentioned factors is advancing up the major channels and their tributaries.
W85-06996

VERTICAL DISPERSION OF SPHERICAL, HEAVY PARTICLES IN TURBULENT OPEN CHANNEL FLOW,
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
M. Bouvard, and S. Petkovic.
Journal of Hydraulic Research, Vol. 23, No. 1, p 5-20, 1985. 12 Fig, 2 Tab, 14 Ref.

Descriptors: *Turbulent flow, *Particulates, *Open channel flow, *Vertical dispersion, Dispersion, Velocity, Flow, Lift, Drag, Hydraulic properties.

The results of an experimental study on the motion of heavy particles (heavier than water) in an open channel flow over a smooth bed are presented. Some aspects of the diffusion and dispersion of the particles are analyzed and especially the effects of lift force and the quadratic nature of drag forces when present. This investigation shows that from isolated particle experiments one obtains a better insight into the mechanisms governing solid particle diffusion and dispersion in turbulent channel flow, than from studies based on the conventional concept of particle concentration. In particular, the particle diameter and the effects of the lift and drag force, if proportional to the square of relative velocity, appear to be the dominant influence in the solid particle dispersion phenomenon. Under identical hydraulic conditions and with the same particle settling velocity in still water, the vertical particle dispersion increases with the diameter. Close to the channel bottom a deficit of particle presence, known as the peripheral layer in blood flow, is noted. The longitudinal particle velocities are lower than the flow velocities due to particle inertia. The longitudinal relative particle velocity is proportional to the shear velocity. Measured vertical downward velocities are 30% lower than particle settling velocities in still water, which is not in accordance with the usual hypothesis adopted in the classical suspension theory. The ultrason-

ic velocity meter, acting like a sonic laser, has proved to be very useful for measuring turbulent flow velocities. (Baker-IVI)
W85-07031

BED DEFORMATION IN CURVED ALLUVIAL CHANNELS,
Waterloopkundig Lab. te Delft (Netherlands).
N. Struiksma, K. W. Olesen, C. Flokstra, and H. J. de Vriend.
Journal of Hydraulic Research, Vol. 23, No. 1, p 57-79, 1985. 16 Fig, 2 Tab, 26 Ref.

Descriptors: *Alluvial channels, *Bed deformation, *River bends, Rivers, Channels, River beds, Flow, Bars, Pools, Bed slope, Model studies, Linear analysis, Wave length.

Large scale bed deformation was studied in alluvial rivers with relatively stable banks. The point bar and pool formation in river bends cannot be described on the basis of local conditions only, that is, the lateral balance between the upslope force induced by the spiral flow and the downslope gravitational force both acting on the grains moving along the bed. The lateral bed slope in a bend is also influenced by transitional effects due to a difference between the conditions upstream and those in the bend. These lead to a substantial overshoot of the lateral bed slope, generally of the same order of magnitude as the slope generated by the local conditions. The wave form of the longitudinal bed profiles in long circular bends is explained with the aid of a linear analysis of the water and sediment motion for the steady state. The main result of this analysis is that it leads to estimates of the wave length and bed oscillation damping rates. A simplified linear analysis, in which the influence of streamline curvature is totally neglected, clearly indicates which effects are the most important for the bed deformation in alluvial rivers. The choice of a specific sediment transport formula determines the sediment transport parameter b, important for bed deformation. It affects the rate of damping in such a way that a decrease of the factor leads to considerable increase of damping. The linear analysis also shows that alluvial similarity in scale models of rivers cannot be achieved if vertical distortion is applied to fulfill the roughness condition. The significant results of this study include an explanation of first bed deformation in river bends in the light of the results of lab experiments in curved flumes with fixed banks. The deformation is then explained in terms of wave length and damping with a linear analysis of the water and sediment motion for the steady state. Finally, the results of computations with a non-linear two-dimensional model are presented, simulating three curved flume experiments. (Baker-IVI)
W85-07033

ENTRAINED AND BED-LOAD SAND CONCENTRATIONS IN WAVES,
Dewberry and Davis, Fairfax, VA.
R. J. Hallermeier.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 111, No. 3, p 567-586, May, 1985. 6 Fig, 36 Ref, 1 Append.

Descriptors: *Entrainment, *Bed load, *Waves, *Sand, Sediment load, Coastal waters, Particulate matter, Suspended sediment.

Using various types of basic empirical results, equations were developed for average volumetric concentration of sediment moving as bed load in nearshore wave environments. Laboratory and natural situations have appreciably different dependences of bed-load concentration on peak flow velocity, with laboratory sediment concentrations being commonly larger than those in nature. Critical examination of published concentration measurements isolates several subsets of near-bed data for quartz sands which allow the two expressions for bed-load concentration to be evaluated. Field and laboratory results in separate categories exhibit distinct functional trends and some quantitative magnitudes agreeing with calculated bed-load concentrations, so that calculation might give a reference value useful for suspended-load computation. Evidence permits a firm conclusion that laboratory near-bed processes and suspended sediment concentrations in usual conditions do not pertain to important field situations. (Author's abstract)
W85-07080

STREAMBANK STABILITY,
Owens (F.W.) and Associates, Inc., Louisville, KY.
F. M. Springer, Jr, C. R. Ullrich, and D. J. Hagerty.
Journal of Geotechnical Engineering, Vol. 111, No. 5, p 624-640, May, 1985. 10 Fig, 7 Tab, 10 Ref, 1 Append.

Descriptors: *Bank erosion, *Bank stability, *Stream banks, *Ohio River, Bank erosion, Computers, Tension cracks, Sand, Groundwater, Flood hydrographs.

The sliding wedge mechanism of erosion of alluvial streambanks was investigated for Ohio River banks. Streambanks were assumed to fail by sliding along sand partings underlying cohesive upper layers. Computer wedge stability analyses indicated that bank stability is most sensitive to the depth of water present in tension cracks behind the face of the bank. Of lesser importance, but of some significance to stability, are the values of the effective angle of internal friction of the sand seams in such banks and the values of unit weight of the soils composing these banks. Changes in the inclination of the sand seams, the coefficients of permeability of the sand seams, the height of capillary rise in the sand seams, the inclination of the top of the bank, the height of the bank, and the flood hydrograph are all of minor importance in changing the stability of the kind of banks studied in this analysis. The time-rate of tension crack formation is a significant factor affecting the total amount of material removed at a particular site in a failing river bank. When it was assumed that tension cracks would form downward from horizontal surfaces in streambanks to only limited depths, analysis predicted the formation of multiple-layered, stepped riverbanks, such as those actually observed in actual river bank failures. (Moore-IVI)
W85-07082

2K. Chemical Processes

DRAINAGE LOSSES OF POTASSIUM FROM A YELLOW-GREY EARTH SOIL,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
C. M. Smith, P. E. H. Gregg, and R. W. Tillman.
New Zealand Journal of Agricultural Research, Vol. 27, No. 3, p 389-397, 1984. 4 Fig, 6 Tab, 11 Ref.

Descriptors: *Potassium, *Drainage, *Pastures, *New Zealand, Leaching, Surface runoff, Tile drainage, Water pollution sources, Rainfall, Grazing, Fertilizers.

Regular potassium topdressing is necessary to maintain high pasture production levels in many areas of New Zealand. Leaching losses of potassium may vary, depending on the soil type, drainage and slope. Dissolved potassium was measured in surface runoff and tile (subsurface) drainage waters from pastures on a yellow-grey earth soil (Tokomaru silt loam). Surface runoff potassium losses from drained and undrained bounded (6 degree) plots were generally very low. The largest loss occurred when topdressing closely preceded (1 day) runoff from an undrained, recently grazed pasture. Under these conditions, total K loss averaged 5.6 kg/ha in 15 weeks, whereas the equivalent fertilizer loss was 6.4% (3.5 kg/ha). A detectable fertilizer effect persisted for 9 weeks. Potassium losses in tile drainage waters from grazed pastures were also minimal, averaging 4.7 and 4.1 kg/ha per year for unfertilized and autumn-fertilized pastures respectively. Surface runoff may be the most important process annually but losses will be of consequence only when heavy rain immediately follows fertilization, and possibly grazing. (Moore-IVI)
W85-06183

SOIL STRUCTURE EFFECTS AND LEACHING OF SODIUM FOLLOWING SODIUM CHLORIDE FERTILISER APPLICATIONS,
Lincoln Coll. (New Zealand). Dept. of Soil Science.
A. S. Black, and B. M. S. Abdul-Hakim.
New Zealand Journal of Agricultural Research, Vol. 27, No. 3, p 399-403, 1984. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Sodium chloride, *Fertilizers, *Sodium, *Leaching, *Soil structure, Calcium, Magnesium, Soil crusting, Electrical conductivity, Soil properties.

Rates of 0, 400, and 2000 kg/ha sodium chloride (NaCl) were applied to a Templeton silt loam in a field trial in May 1981. Soil samples were collected at intervals until October 1981. Although some sodium (Na(+)) was leached to 60 cm during winter, most remained in the upper 20 cm of soil. This resulted in some increase in calcium and magnesium leaching, and produced deterioration in soil structure, observed as crusting and reduced stability indices using the Emerson test. Structure breakdown was associated with low electrical conductivity of soil extracts, and exchangeable Na(+) percentages as low as 2. (Author's abstract)
W85-06184

CONCURRENT DENITRIFICATION AND OXYGEN UPTAKE IN MICROBIAL FILMS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
S. E. Strand, A. J. McDonnell, and R. F. Unz.
Water Research, Vol. 19, No. 3, p 335-344, 1985. 7 Fig, 8 Tab, 61 Ref.

Descriptors: *Denitrification, *Oxygen, *Microbial films, Microorganisms, Films, Nutrients, Dissolved oxygen, Mathematical models.

Mixed microbial films were grown on the inner walls of a tubular reactor with recirculation of the reactor contents and continuous flow-through of nutrient solution. The loss of total oxidized nitrogen was correlated to film population, the nitrite concentration and the dissolved oxygen concentration in the reactor. When film population was greater than 0.5 x 10 to the 9th power cells/sq cm, reactor dissolved oxygen concentration greater than 1 mg/l had little effect on the nitrate loss. Nitrate loss declined for film populations greater than 2 x 10 to the 9th power cells/sq cm. Models based on Monod and zero-order microbial kinetics were calibrated using these data and a nonlinear least squares method. There was little difference in the residual errors with these methods. (Author's abstract)
W85-06226

PARTICLE DISCRIMINATION EFFECTS IN THE DETERMINATION OF TRACE METALS IN NATURAL FRESH WATERS,
Oslo Univ. (Norway). Inst. for Kjemi.
For primary bibliographic entry see Field 5A.
W85-06252

USE OF THE L'VOV PLATFORM AND MOLYBDENUM COATING FOR THE DETERMINATION OF VOLATILE ELEMENTS IN THERMOMINERAL WATERS BY ATOMIC ABSORPTION SPECTROMETRY,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 5A.
W85-06253

STUDIES ON DESTRUCTION OF ORGANIC SUBSTANCE OF HIGHER AQUATIC PLANTS BY LABORATORY WATER COURSE MODELS (IZUCHENIE DESTRUKTSII ORGANICHESKOGO VESHCHESTVA VYSSHIKH VODNYKH RACTENII NA LABOPATORNYKH MODELYAKH VODOTOKOV),
G. N. Oleinik, and V. M. Yakushin.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 20-27. 4 Fig, 2 Tab, 22 Ref.

Descriptors: *Decomposition, *Organic matter, *Aquatic plants, *Model studies, Water chemistry, Bacteria, Macrophytes.

Decomposition of different higher aquatic plants under laboratory conditions is investigated by means of water course models. It is established that the rate and decomposition completeness as well as dynamics of hydrochemical and bacteriological indices are determined by the peculiarities of the macrophyte chemical content. Differences between the decomposition of higher aquatic plants in closed vessels and in water course models are shown. (Author's abstract)
W85-06376

CARBON FLOW IN THE PELAGIC ZONE OF A SHALLOW TURBID IMPOUNDMENT, WURAS DAM,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W85-06391

TRANSFORMATIONS OF NITROGEN FOLLOWING AN EPILIMNETIC NITROGEN FERTILIZATION IN CASTLE LAKE, CA: 1. EPILITHIC PERIPHYTON RESPONSES,
California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 2H.
W85-06397

UPTAKE OF PHOSPHATE AND INORGANIC NITROGEN BY A SEDIMENT-ALGAL SYSTEM IN A SUBARCTIC LAKE,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W85-06415

CERTAIN RESULTS OF MUD DEPOSIT FRESHENING IN THE LIMAN SASYK (NEKOTORYE REZUL'TATY OPRESNENIYA ILOVYKH OTLOZHENII LIMANA SASYK),
For primary bibliographic entry see Field 2L.
W85-06476

STUDY OF THE PH OF RAIN IN LAFAYETTE, LOUISIANA,
University of Southwestern Louisiana, Lafayette. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W85-06489

SOLUBLE PHOSPHORUS RELEASE FROM ORGANIC SOILS,
Agricultural Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 5B.
W85-06635

DO-PROCESS MODELS FOR SHALLOW SYSTEMS. PART 1: PONDS AND LAKES,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
A. Gnauck, and W. Winkler.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 109-124, 1983. 9 Fig, 6 Tab, 29 Ref.

Descriptors: *Ponds, *Lakes, *Dissolved oxygen, Model studies, Water quality, Solar irradiation, Plankton, Water temperature, Mathematical models.

Model statements are presented for describing the dissolved oxygen (DO) concentration in dependence on various system quantities and five different shallow water bodies. A nonlinear model in the form of a polynomial and with parameter estimation by means of recursive regression proves suitable. It is a blackbox model in which the water temperature, the biomass of phytoplankton and zooplankton and the solar irradiation are the most important input quantities. For all investigations performed by normal and recursive regressive methods a connection between the number of inputs, the convergency of the parameters and the ability of the model output to follow the system output was considered. Dissolved oxygen concentrations cause disturbances, where the recursive algorithm is not able to follow the system output. During oversaturations the error between real and estimated DO runs up to 100%. Changes of the weighting factors and of the starting matrix of the algorithm delivered unessential model improvements. The best correspondence of model and system output was obtained by autocorrelation models with performance indices of about 97%. The investigations show that the precision of the estimation and the following applications depend on the adaptability of the model structure to the real problem on the number of data sets and on the number of parameters used. If the investigated objects have a different state behavior over a year, it should be possible to describe the global system behavior by means of separate models valid for a restricted zone only. Comparing the results obtained by modelling shallow lakes with those of drinking water reservoirs and rivers, it is noted that the regression method used is more effective than in the cases regarded in this paper. (Baker-IVI)
W85-06655

SALT AND WATER TRANSPORT IN UNSATURATED SOIL FOR NON-CONSERVATIVE SYSTEMS,
Arizona Univ., Tucson. Dept. of Mathematics.
For primary bibliographic entry see Field 2G.
W85-06686

MINERALOGICAL CHANGES ALONG THE FRESHWATER/SALTWATER INTERFACE OF A MODERN AQUIFER,
Florida Univ., Gainesville. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W85-06700

LABORATORY INVESTIGATION OF LEACHATE CHEMISTRY FROM SIX APPALACHIAN FOREST FLOOR TYPES SUBJECTED TO SIMULATED ACID RAIN,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
D. R. De Walle, G. C. Ribblett, J. D. Helvey, and J. Kochenderfer.
Journal of Environmental Quality, Vol. 14, No. 2, p 234-240, April/June, 1985. 2 Fig, 5 Tab, 16 Ref.

Descriptors: *Leachate, *Forest soils, *Acid rain, *Soil chemistry, Organic acids, Hydrogen ion concentration, Oak trees, Pine trees, Calcium, Magnesium, Calcium, Hemlock trees, Water pollution effects.

In order to determine the role of the forest floor in neutralization of strong acidity in acid rain, simulated acid rain at pH 4.0 was applied under laboratory conditions to forest floor samples from six Appalachian forest types. Effects of forest type, storm size, and repeated storm applications on leachate chemistry were investigated. Forest floor leachate from a hemlock forest (Tsuga canadensis (L.) Carr.) showed significantly lower pH (mean pH 3.9) than other leachate types due to high concentrations of organic acids. Cove hardwood forest found in an area with calcareous soil parent material produced forest floor leachate with a significantly higher pH (mean pH 6.5) than other forest types. Forest floor leachates from mixed oak (Quercus spp.), northern hardwood, red pine (Pinus resinosa Ait.), and white pine (P. strobus L.) forest were intermediate in pH (mean pH 4.1-4.4) due to the acidifying influence of organic acid leaching balanced against the neutralizing effect of H(+) exchange for Ca(2+) in the forest floor. Weak acidity concentrations obtained by Gran plots were well correlated with 400-nm wavelength transmittance and anion deficits in the leachates. Organic anions dominated leachates from hemlock and mixed oak forest types. Increasing storm sizes caused reduced ionic concentrations, especially of H(+), Mg(2+), and Ca(2+), but three repeated storms produced no consistent significant reductions in loads or concentrations. (Author's abstract)
W85-06721

DISSOLVED SILICON IN A NORTH WALES CATCHMENT OF HIGH RELIEF,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
D. T. E. Hunt, and P. Foster.
Water Resources, Vol. 19, No. 4, p 415-421, 1985. 6 Fig, 2 Tab, 28 Ref.

Descriptors: *Afon Anafon, *Wales, *Silicon, *High relief, *Topography, Nitrogen, Discharge, Catchments, Nitrates, Salinity, Afforestation, Tracers.

Concentrations of dissolved silicon and nitrogen in the Afon Anafon, a river draining the mountainous region of North Wales, were monitored over an annual cycle. As a result of high relief the silicon concentration in the baseflow was diluted by surface flow and interflow. This led to low silicon concentrations in the river water (maximum 1540 micro-g/l, minimum less than 100 micro-g/l) an inverse relationship between silicon concentration and discharge and a low removal rate of silicon by dissolution from the catchment of 0.07 mg silicon dioxide per sq cm/yr. Nitrate concentrations, in contrast, showed a typical seasonal variation and were less affected by variations in the discharge. The conclusion that silicon concentration in the Anafon is a strong function of discharge and therefore highly variable on a relatively small time scale does not invalidate the use of dissolved silicon as a tracer of major fluvial discharges in coastal waters. Data on dissolved silicon in large catchments indicates that the concentration is invariably not significantly diluted by inflow. In rivers of high relief and limited length, the residence time of the inflow will be insufficient to allow it to acquire concentrations of dissolved silicon comparable to that of baseflow before reaching the coast. Waters along the North Wales coast in the region of the Menai Strait receive the fresh water discharges from the Anafon and similar small rivers draining catchments of high relief. The use of silicate as a tracer in these coastal waters is totally inappropriate. Marked temporal variations in the silicon levels in the fluvial discharges will inflict upon the receiving waters a salinity to silicate relationship of considerable complexity. (Baker-IVI)
W85-06728

EFFECT OF STORMS ON NITRIFICATION RATES IN A SMALL STREAM,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. B. Williamson, and J. G. Cooke.
Water Research, Vol. 19, No. 4, p 435-440, 1985. 6 Fig, 11 Ref.

Descriptors: *Nitrification, *Streams, *Waiohewa Stream, *Rotorua, *New Zealand, Nitrogen, Nitrites, Nitrates, Ammonia, Nitrogen cycle, Scouring, Storms.

The impact of storms on nitrification rates was examined over a 2 month period in the Waiohewa Stream, Rotorua, New Zealand. This stream receives high concentrations of geothermally derived ammonia. Changes in mass flows of ammonium and nitrogen (nitrate plus nitrite) were used to calculate apparent nitrification rates. Concentrations of nitrogen and ammonium at both upstream and downstream sites were clearly influenced by flow, although they showed quite different behavior. The results suggest that under baseflow conditions there is no apparent increase of nitrification with time since the last flood event, due to a build up of nitrifiers in the surficial sediments of the stream. In situ measurements showed sudden reduction in benthic nitrifying activity after storm events followed by gradual recovery during stable periods. These organisms are susceptible to removal by scouring at high flow, which leads to a decrease in nitrification rate. Studies on the Waiohewa Stream have found a variation in apparent nitrification rates (ANR) from 36 to 108 mg/sq m/hr of N which can largely be explained by the preceeding hydrological conditions. The recovery period for ANR is quite long, greater than 14 days after one storm, after the system has been per-

turbed by high flows. Any study of stream water quality parameters controlled by sediment-related phenomena should consider not only current hydrological conditions but also those occurring in the stream's recent history. (Baker-IVI)
W85-06730

DETERMINATION OF CL-, NO3- AND SO42- IN PORE WATERS OF SEDIMENTS,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofftechnologie und Chemie.
R.-D. Wilken, and H. H. Kock.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 477-479, March, 1985. 4 Fig, 2 Tab, 3 Ref.

Descriptors: *Ion chromatography, *Interstitial water, *Chlorides, *Nitrates, *Sulfates, Elbe River, Germany (Federal Republic), Water analysis, Chromatography.

Ion chromatography was employed as the most suitable method for determining chloride, nitrate, and sulfate ions in pore waters of sediments. An eluent mixture of 0.003 molar NaHC03 and 0.0024 molar Na2C03 was used. Detection limits of the technique approximate those of classical methods, color of pore water liquids is not a problem (as it would be with photometric techniques), no interference from varying concentrations of other ions could be detected, usually no more than 100 microliter of sample was needed, all three anions could be determined in one step, and the method was automated and could be conducted with reasonable staff effort. Results are presented for three samples of Elbe River (northern Federal Republic of Germany) sediment core material: (1) from Muehlenberger Loch, in the limnic region, near the city of Hamburg, (2) from the mixing zone, near the Stoer River mouth, and (3) from the outer estuary (Neufelder Watt). Pore water analyses were conducted for samples at 5-cm intervals from the surface to at least 30 cm depth in the sediment. (Rochester-IVI)
W85-06756

RADIONUCLIDE SORPTION AND DESORPTION REACTIONS WITH INTERBED MATERIALS FROM THE COLUMBIA RIVER BASALT FORMATION,
Atomics International Div., Richland, WA. Energy Systems Group.
For primary bibliographic entry see Field 5B.
W85-06773

INTERACTION OF GROUNDWATER AND BASALT FISSURE SURFACES AND ITS EFFECT ON THE MIGRATION OF ACTINIDES,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5B.
W85-06774

WITHOUT WATER THE WORK OF DEATH WOULD BE INCOMPLETE,
Glasgow Univ. (Scotland). Dept. of Microbiology.
A. C. Wardlaw.
Glasgow Naturalist, Vol. 20, No. 5, p 421-433, 1984. 3 Fig, 4 Tab, 5 Ref.

Descriptors: *Decomposition, *Biodegradation, Bacteria, Fungi, Soil, Wastewater, Seawater, Microbial decomposition, Chlorinated hydrocarbons, Biological magnification, Food chains.

The carbon cycle and the role of bacteria and small fungi in it are reviewed, and factors that may prevent natural microbial degradation of organic material are discussed. Microbes are the primary agents of decomposition on land and in the sea; water is a necessity for their activities. Although not visible, bacteria are abundant in many habitats, such as soil, human skin, human feces, and seawater. There are six main factors that regulate the microbial degradation of organic materials, as follows: (1) intrinsic biodegradability of the substrate, (2) access of the microbes to the substrate, (3) presence of water or moisture, (4) temperature in the range 0-100 degrees C, (5) presence of oxygen, and (6) absence of preservative substances. Natural organic substances are intrinsically biodegradable. Man-made substances, such as plastics and pesticides, tend to be very resistant to microbial attack. Chlorinated hydrocarbons present a special problem, because they resist biodegradation, are not visible to the naked eye, and tend to become more concentrated in organisms as they ascend through the food chain. Examples of prevention of biodegradation can be found as a result of failure of each of the six necessary conditions to be met. Deliberate employment of these factors occurs in preservation of foods. Natural occurrences of absence of the factors, such as when artifacts sink into oxygen-less, acidic bog muds, account for preservation of biodegradable materials. (Rochester-IVI)
W85-06800

INFLUENCE OF A KARST ON CHEMICAL COMPOSITION OF RIVER WATERS AND THE DISSOLVED SUBSTANCES FLOW (VLIYANIE KARSTA NA KHIMICHESKII SOSTAV RECHNYKH VOD I STOK RASTVORENNYKH VESHCHESTV),
L. V. Balkova.
Vestnik Leningradskogo Universiteta Geologiia-Geograffiia, Vol. 24, p 92-96, 1984. 4 Tab, 4 Ref.

Descriptors: *Rivers, *Chemical composition, *Dissolved solids, *Bashkiria, *USSR, *Karst, Geohydrology, Salts, Basins, Salt balance.

The formation of the water-salt balance of river basins of the Bashkiria under the conditions of karst formation was studied. The salt balance components, such as atmospheric ion receipt salt evaporation, and the influence of water flow on chemical flow were analyzed. Special attention was given to the influence of the lithology of karsting rocks on chemical composition of river waters and the flow of dissolved substances. The chemical compositon of river waters in karsting and non-karsting basins was compared. General salt balance and salt balance for some kinds of ions in the river basins of the Bashkiria were calculated. (Author's abstract)
W85-06809

CHEMICAL EQUILIBRIUM MODEL FOR THE ILLINOIS BASIN FORMATION WATERS,
University of Western Ontario, London. Dept. of Geology.
H. W. Nesbitt.
American Journal of Science, Vol. 285, No. 5, p 436-458, May, 1985. 4 Fig, 1 Tab, 29 Ref, 1 Append.

Descriptors: *Model studies, *Illinois Basin, *Geohydrology, *Groundwater, *Chemical reactions, Water chemistry, Clay minerals, Sandstone, Calcium, Sodium, Diagenesis, Magnesium.

The chemical composition of formation waters collected from Pennsylvanian and Mississippian (Aux Vase Sandstone and younger) strata probably are controlled by mineral transformation reactions involving kaolinite, illite, a sodic clay mineral, and calcite rather than being controlled by cation exchange reactions between the solutions and clay minerals. The reactions involve conversion of the constituents, kaolinite, calcite, and aqueous Na(+) (+ or - illite), to a sodic-clay mineral and aqueous Ca2(+) (+ or - illite) during subsurface concentration of the waters, but the reactions proceed in the reverse direction, when the relatively concentrated formation waters are mixed with dilute near-surface meteoric waters. The reactions are late diagenetic in that they are proceeding now. They mask evidence of other early diagenetic reactions as well as evidence concerning the composition of the original solutions of the basin. Generally, no significant amounts of Mg have been added to or removed from the present formation waters during their chemical evolution; consequently, there is no evidence for chloritization or for dolomitization of the sedimentary rocks by the solutions now in the basin. Only if the bulk of the solutes were derived from seawater would Mg have to be removed from the formation waters, and Mg extraction would have had to occur during an early diagenetic stage. (Author's abstract)
W85-06872

STREAM WATER QUALITY IN THE COAL REGION OF TENNESSEE,
Northeastern Forest Experiment Station, Berea, KY.
For primary bibliographic entry see Field 5C.
W85-06980

SIGNIFICANCE OF SOLVATION PHENOMENA FOR THE PARTITION OF HALOGENATED ORGANIC COMPOUNDS BETWEEN WATER AND A PARAFFINIC PHASE (DIE BEDEUTUNG DER SOLVATATION FUR DIE VERTEILUNG VON HALOGENORGANISCHEN VERBINDUNGEN ZWISCHEN WASSER UND EINER PARAFFINPHASE),
Essen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich Chemie.
P. Belouschek, and V. Neitzel.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 2, p 51-55, April, 1985. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Solvation phenomena, *Partitioning, *Halogenated hydrocarbons, *Paraffinic phase, Thermodynamics, Chemical reactions, Hydration.

The distribution behavior of halogenated organic compounds (halobenzenes and chlorophenols) between water and a paraffinic phase (decane/decanol) is characterized by changes of intermolecular interactions arising between the partitioning substances and the adjacent water or paraffin molecules. These phenomena may be described by means of the thermodynamic parameters of transfer. The influence of the solvation or hydration on the distribution is distinctly indicated by the temperature dependence of the partition coefficient. The importance of solvation in favor of the distribution behavior is clearly evident when correlating the free enthalpies of transfer and solution of the halogenated organic compounds. (Author's abstract)
W85-07024

BEHAVIOUR OF DISSOLVED IODINE IN THE UPPER ST. LAWRENCE ESTUARY,
Centre Champlain des Sciences de la Mer (Quebec).
K. Takayanagi, and D. Cossa.
Canadian Journal of Earth Sciences, Vol. 22, No. 4, p 644-646, April, 1985. 4 Fig, 13 Ref.

Descriptors: *St. Lawrence Estuary, *Iodine, *Iodate, Estuaries, Salinity, Mixing, Seawater, Water chemistry.

The behavior of dissolved total iodine and iodate in the upper St. Lawrence Estuary was determined by both field and laboratory experiments. The concentration of total iodine, in general increased with increasing salinity from undetectable at salinity 0 0/00 to 0.40 micro-M at salinity 33.9 0/00 (seawater). The concentration of total iodine linearly correlates with salinity with a correlation coefficient of 0.96. During the mixing between river water and seawater in the estuary, both total iodine and iodate were conservative and no interconversion occurred between them. The laboratory mixing experiments confirmed this phenomena. Iodate, the thermodynamically stable species, was the predominant species throughout the estuary, constituting up to 90% of the total dissolved iodine. (Baker-IVI)
W85-07036

APPLICATION OF REVERSED-PHASE LIQUID CHROMATOGRAPHY TO DISSOLVED ORGANIC MATTER IN ESTUARINE SEAWATER,
Hiroshima Univ. (Japan). Faculty of Integrated Arts and Sciences.
For primary bibliographic entry see Field 5A.
W85-07065

NEW METHOD FOR MONITORING TEMPORAL TRENDS IN THE ACIDITY OF FRESH WATERS,

Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 5A.
W85-07143

2L. Estuaries

RESPONSE OF PLANKTONIC AND MICROBENTHIC ALGAL ASSEMBLAGES TO NUTRIENT ENRICHMENT IN SHALLOW COASTAL WATERS, SOUTHWEST SWEDEN,
Lund Univ. (Sweden). Dept. of Marine Botany.
E. Graneli, and K. Sundback.
Journal of Experimental Marine Biology and Ecology, Vol. 85, No. 3, p 253-268, 1985. 8 Fig, 2 Tab, 29 Ref.

Descriptors: *Sweden, *Phytoplankton, *Nutrients, *Coastal waters, Microbiological studies, Nitrogen, Phosphorus, Algae, Benthic flora, Biomass, Algal growth, Solar radiation.

Field and laboratory nutrient enrichment experiments were performed using natural phytoplankton and microphytobenthic assemblages from the brackish water Oeresund, Sweden. The response of algae from a low nutrient area, Falsterbo Canal, was compared to that of algae from a polluted, nutrient rich area, Lomma Bay. Both phytophankton and microphytobenthos were nitrogen limited in the Falsterbo area. The phytoplankton responded with a much higher increase in chlorophyll than the microphytobenthos. The slower increase in microphytobenthos biomass can be explained in two ways: the biomass of microphytobenthos is initially high because of adequate nutrient conditions, and the microphytobenthos receive light only through the sediment so that light becomes the factor that is most limiting, not nutrient availability. Water from Lomma Bay, which contained high concentrations of inorganic nitrogen, stimulated phytoplankton growth markedly, and, when P was added as well, an even higher biomass was obtained. (Baker-IVI)
W85-06210

EFFECTS OF MUSSEL AQUACULTURE ON THE NITROGEN CYCLE AND BENTHIC COMMUNITIES IN KENEPURU SOUND, MARLBOROUGH SOUNDS, NEW ZEALAND,
Cawthron Inst., Nelson (New Zealand).
H. F. Kaspar, P. A. Gillespie, I. C. Boyer, and A. L. MacKenzie.
Marine Biology, Vol. 85, No. 2, p 127-136, February, 1985. 7 Fig, 6 Tab, 29 Ref.

Descriptors: *Kenepuru Sound, *Marlborough Sounds, *New Zealand, *Mussels, *Aquaculture, *Nitrogen, Cycling nutrients, Benthic environment, Sediments.

Fluctuations in the meat condition of farmed green-lipped mussels in the Marlborough Sounds, New Zealand, may be related to the availability of inorganic nitrogen to phytoplankton, a major food for mussels. Nitrogen pools and transformations and benthic communities at a mussel farm and a nearby reference site without direct influence of marine farming in Kenepuru Sound, were compared on four dates between September 1982 and May 1983. The organic nitrogen pool in the top 12 cm sediment was 7.4 to 10.8 mol/sq m at the mussel farm and 6.1 to 8.9 mol/sq m at the reference site. The water analysis showed a more or less even distribution of chemical species throughout the water column. The higher volatile solids content of the mussel-farm sediment indicated an elevated organic-matter content at this site. No significant differences in the water chemistry could be found between the mussel farm and the reference site. Sediments at the mussel farm site were slightly finer textured than those of the reference site. The sediment surface at both sites supported a large epibenthic microflora which was visible as a yellow green mat. The rates of nitrogen mineralization in the mussel-farm sediment were markedly higher than in the reference sediment. (Baker-IVI)
W85-06211

NITROGEN, PHOSPHORUS AND PRIMARY PRODUCTION IN THE POMERANIAN BAY,
Akademia Rolnicza w Szczecinie (Poland). Inst. of Fisheries, Oceanography and Protection of the Sea.
J. Kubiak.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 439-447, 1983. 1 Fig, 5 Tab, 39 Ref.

Descriptors: *Pomeranian Bay, *Baltic Sea, *Nitrogen, *Phosphorus, *Primary productivity, Eutrophication, Phytoplankton, Nutrients, Ammonium, Limiting nutrients, Marine environment.

The Pomeranian Bay in the south-western part of the Baltic sea has an area of 4300 sq km and a volume of 51.4 cu km and contains a fresh-water inflow of 17.3 cu km/a from a catchment area of 137,220 sq km. Data were evaluated from 18 investigations at 14 stations in the years 1976-1978: 229-235 hydrochemical measurements and 75 phytoplankton investigations. It can be demonstrated by multiple regression analyses that the nutrient concentrations are mainly determined by the fresh-water inflow and the mixing ratios, phytoplankton having a secondary effect. Of the nutrients, mainly ammonium influences the phytoplankton development and the oxygen production, the full utilization of the nitrogen stock being limited by an N/P ratio of 48 in the surface water and of 41 in the bottom water layers. Obviously, a limitation of the primary production is out of the question due to the high turnover rates of phosphorus. The N/P ratio is also a clear evidence of the great influence of the inflowing nitrate-rich freshwater on the nutrient situation of the bay. (Author's abstract)
W85-06270

MACROPHYTE VEGETATION AT THE RIVER KYRONJOKI ESTUARY IN 1982,
Jyvaeskylae Univ. (Finland). Inst. for Environment Research.
J. J. Merilainen.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 61-76, 1984. 9 Fig, 4 Tab, 25 Ref, 2 Append.

Descriptors: *Macrophytes, *Aquatic plants, *Estuarine environment, *River Kyronjoki, *Finland, Vegetation, Biomass, Aerial photography, Mapping, Spatial distribution, Acidity, Water pollution effects.

This study presents maps of large areas of macrophyte vegetation in the upper part of the River Kyronjoki estuary (Finland) in the southern Bothnian Bay (63 degrees 20' N). The vegetation maps are based on color slides taken on August 17, 1982 from a height of 900 m. The more scanty vegetation of the lower estuary was also described. The study is part of a large scale investigation into the conditions prevailing at the estuary, on the basis of which is should be possible to observe the natural succession, as well as the possible biological effects caused by the extensive works in the course of the river. More than two-thirds of the total area mapped (17.97 sq km) was covered with aquatic plants, open water accounted for a quarter and shore vegetation 6% of the total. Phragmites australis, Scirpus lacustris, Nuphar lutea and Nymphaea candida were the most important species of the area. The previously documented deleterious influence of the acid waters in aquatic animals in the limnic zone was not pronounced on the vegetation. However, the distribution of some species was possibly restricted by the acidity, e.g. the Potamogeton perfoliatus zone, important in the outer estuary, was totally absent from the limnic zone. The plant biomass of the upper estuary. 0.4 kg dry mass per square meter (about 6,400 tons for the whole area) was very high compared with the few values hitherto reported from the Bothnian Bay and its inlets. (Author's abstract)
W85-06297

PLANT ZONATION AND THE EFFECTS OF THE SPRING-NEAP TIDAL CYCLE ON SOIL AERATION IN A HUMBER SALT MARSH,
Hull Univ. (England). Dept. of Plant Biology.
W. Armstrong, E. J. Wright, S. Lythe, and T. J. Gaynard.
Journal of Ecology, Vol. 73, No. 1, p 323-339, March, 1985. 10 Fig, 37 Ref.

Descriptors: *Species distribution, *Salt marshes, *Vegetation, *Tidal effects, Seasonal variation, Drainage, Topography, Soil aeration, England, Welwick.

Relationships were sought between species distribution, soil aeration and tidal activity in Welwick (England) a well zoned, upgraded salt marsh. Redox potential was used as an index of soil aeration and was measured with platinum electrodes permanently installed in the soil to various depths in major vegetation zones. Tidal activity and drainage, influenced by topography and elevation, clearly had strong roles to play in creating substantial temporal and zonal differences in the aeration of soils within a salt marsh ecosystem. At Welwick, the zonal distribution of the vegetation correlated with, and consequently could be dependent upon, differences in degree and temporal pattern of soil aeration. Three basic aeration patterns emerged at Welwick in summer. The first was characteristic of Spartina-dominated sites with reducing conditions persistent throughout much of the profile and indifferent to periods of exposure. Neap tides were responsible only for a series of peaks indicating brief intervals of surface oxidation. The second pattern was characteristic of Puccinellia, Halimione and Elymus sites. A tidal effect caused by high spring tides, occurred only monthly. Finally there was a pattern associated with the general salt marsh and its sub-sites. The high spring tides of early July had no significant effect on the general salt marsh and there was thus a longer period of oxidation, free from fluctuations, than at any other site. Although there is a close relationship between soil aeration and tidal activity, and in turn the vegetation types are closely related to the frequency of tidal flooding, it does not necessarily follow that there is a causal relationship between soil aeration and vegetation type. Little evidence for the persistence of an aerated layer trapped between tide and water table has emerged in this study. (Baker-IVI)
W85-06369

NUTRIENT ENRICHMENT OF CHESAPEAKE BAY AND ITS IMPACT ON THE HABITAT OF STRIPED BASS: A SPECULATIVE HYPOTHESIS,
Delaware Univ., Lewes. Coll. of Marine Studies.
K. S. Price, D. A. Flemer, J. L. Taft, G. B. Mackiernan, and W. Nehlsen.
Transactions of the Americal Fisheries Society, Vol. 114, No. 1, p 97-106, January, 1985. 6 Fig, 2 Tab, 23 Ref.

Descriptors: *Chesapeake Bay, *Fish, *Population dynamics, Nutrients, Dissolved oxygen, Nitrogen, Phosphorus, Temperature effects, Bays.

Stocks of striped bass Morone saxatilis have declined in the Chesapeake Bay system over the last decade. Evidence is presented for the working hypothesis that the decline has resulted, in part, from loss of deep-water habitat for adults, caused by limiting concentrations of dissolved oxygen that are related, in turn, to nutrient enrichment and greater planktonic production. A related hypothesis is that changes in the near-shore habitat for juvenile striped bass, involving severe declines in submerged aquatic vegetation due to nutrient-driven planktonic shading, also have contributed to the decline of striped bass. Nutrients (nitrogen and phosphorus) and chlorophyll a, an indicator of phytoplankton biomass, have increased in many areas of the bay and tributaries over the past 20 to 30 years. These trends are qualitatively correlated with greater deoxygenation of the deep channel in the mid and upper bay. During the late 1970s, summer concentrations as low as 2 ml/liter approached to within 7-8 m of the surface, allowing water stressful to striped bass to intrude onto shoal areas of the bay. The volume of Chesapeake Bay bottom waters containing 0.5 ml O2/liter or less was about 15 times greater in July 1980 than in July 1950. The combination of the expanding hypoxic pool and summer temperatures above preferred levels for adult striped bass may contribute to an oxygen-temperature squeeze that forces adults onto shoal areas of the bay or out of the

upper bay. Many of these shoal areas now lack suitable cover for juvenile striped bass and their prey. Strong intraspecific competition among striped bass may be occurring there. (Author's abstract)
W85-06409

RESIDENCE TIME OF WATER IN NARRAGANSETT BAY,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
M. E. Q. Pilson.
Estuaries, Vol. 8, No. 1, p 2-14, March, 1985. 6 Fig, 8 Tab, 32 Ref.

Descriptors: *Narragansett Bay, *Rhode Island, *Flushing, Bays, Salinity, Wind speed.

For Narragansett Bay, Rhode Island, newly calculated and archival data for the area, mean depth, total volume, mean salinity and fresh water input are presented. Estimates of the residence time of the water, derived from 22 sets of monthly mean values, were related to estimates of the fresh water input according to an empirical relationship involving the flushing time in days, and the fresh water input in cu m per S. Adding estimates of the mean wind speed into a multiple regression increased the correlation coefficient only to 0.864. At the long-term mean rate of fresh water input (105 cu m per s) the flushing time in 26 days. At the lowest mean monthly input rate observed the flushing time was nearly 40 days, while at the highest mean monthly input rate in the data set (325 cu m per s) the flushing time was about 10 days. Known sources of random error appear sufficient to account for most of the deviations from the relationship. The evidence suggests that variation in the flushing time is largely determined by variation in the fresh water input.
W85-06411

SEASONAL VARIATION OF DISSOLVED ORGANIC MATTER IN FUNKA BAY,
Hokkaido Univ., Sapporo (Japan). Research Inst. of North Pacific Fisheries.
H. Yoshida, Y. Maita, and A. Shiomoto.
Bulletin of the Faculty of Fisheries, Hokkaido University, Vol. 35, No. 4, p 254-270, 1984. 7 Fig, 2 Tab, 44 Ref.

Descriptors: *Funka Bay, *Dissolved solids, *Seasonal variation, Lipids, Polysaccharides, Amino acids, Monosaccharides, Carbohydrates, Amino acids, Chlorophyll.

The seasonal variation of dissolved organic matter (DOM), i.e., total dissolved lipids (DL), total dissolved polysaccharides (DPS), total dissolved monosaccharides (DMS), total dissolved combined amino acids (DCAA), and total dissolved free amino acids (DFAA), was investigated in Funka Bay from January 1983 to January 1984 using R/V Ushio Maru. Each component of DOM changed drastically in relation to time and space. The concentration ranges and the mean values of DL, DPS, DMS, DCAA and DFAA in station 30, were 11-200 (76, n = 134), 33-2800 (220, n = 155), 28-1200 (120, n = 156), 37-3700 (240, n = 156) and 1.5-400 (30, n = 156) as microg C/l, respectively. Concentrations of DOM increased during the periods when diatom bloomed in the spring and when water temperature rose in the summer. Standing stocks of DOM throughout the water column (from surface to 92 m in depth) were estimated at 9.7 g C/sq m for DL, 64.0 g C/sq m for DPS, 21.6 g C/sq m for DMS, 54.1 g C/sq m for DCAA and 3.6 g C/sq m for DFAA in the spring, and at 8.0 g C/sq m for DL, 22.0 g C/sq m for DPS, 20.1 g C/sq m for DMS, 46.7 g C/sq m for DCAA and 6.3 g C/sq m for DFAA in the summer. In the fall, carbohydrates and amino acids also increased in response to the higher concentration of chlorophyll a. Standing stocks of DOM throughout the water column were estimated at 25.2 g C/sq m for DPS, 10.6 g C/sq m for DMS, 16.6 g C/sq m for DCAA and 2.3 g C/sq m for DFAA during this period. The water depth in which higher concentrations of DOM were formed differed both vertically and temporally. It is presumed that these results reflected increases and decreases in the DOM components. (Author's abstract)
W85-06441

FRESH WATER-SALT WATER INTERFACE IN FRENCH FLANDERS (L'INTERFACE EAU DOUCE-EAU SALEE EN FLANDRES FRANCAISES),
Angers Univ., Besancon (France). Lab. de Geologie Structurale et Appliquee.
J. Mania, and V. Meens.
Bulletin de la Societe Geologique de la France, Vol. 26, No. 7, p 1281-1291, 1984. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Seawater, *Saline water intrusion, *Encroachment, *Coastal aquifers, *Maritim Flanders, Groundwaters, Agricultural dewatering, Drainage.

The encroachment of sea water into the coastal aquifer of the Maritim Flanders over about 700 sq km, is investigated. Special consideration is given to the interference of agricultural dewatering on the position of the interface between fresh and shallow saline groundwaters. Dewatering increases the salinity of groundwaters. These groundwaters are then transferred through distributtion channels for successive industrial uses. Measurements of hydraulic conductivity, salinity and water levels during low and high water cycles have been taken using 258 piezometers distributed on 86 observation sites during 1979-1980. A comparison was made of field results and simulations of interface fluctuations obtained by using a mathematical model with boundary elements on heterogeneous anisotropic soil. This comparison allowed the optimization of the dewatering system which will be used. Three simulated maps (at one, three and five days) of the geographical evolution of saline zones induced by systematic drainage are given. (Baker-IVI)
W85-06447

ENERGY RESERVE IN ORGANIC MATTER AND IN SOME REDUCED MINERAL COMPOUNDS OF THE BLACK SEA (ZAPAS ENERGII V ORGANICHESKOM VESHCHESTVE I NEKOTORYKH VOSSTANOVLENNYKH MINERAL'NYKH SOEDINENIYAKH VOD CHERNOGO MORYA),
B. A. Skopintsev, A. A. Novoselov, and L. I. Man'Kovskaya.
Okeanologiya, Vol. 24, No. 5, p 764-771, November/December, 1984. 3 Tab, 35 Ref.

Descriptors: *Energy, *Organic matter, *Black Sea, Phytoplankton, Anaerobic conditions.

Calculating in a manner similar to that used to determine energy reserves for the World Ocean organic matter (OM), energy reserve in the Black Sea organic matter and annual phytoplankton production were determined to be 1.3 times 10 to the 16th power Kcal and 0.9 times 10 to the 15th power Kcal, respectively. However, there is every reason to suppose that the data on OM calloricity for the anaerobic zone are lower than true values, as the volume of this zone is 87% of the whole volume of the Black Sea water, and since the OM of this zone is more reduced (less oxidized) than the OM of the anaerobic zone. Energy reserve in hydrogen sulfide (sulfides) and in ammonium nitrogen of the anaerobic zone is 1.7 times 10 to 16th power Kcal and 2.1 times 10 to the 15th power Kcal, respectively. (Author's abstract)
W85-06456

METHOD OF PERFORMING ECOTOXICOLOGICAL EXPERIMENTS IN SITU (METODIKA POSTANOVKI EKOTOKSIKOLOGISCHESKOGO EKSPERIMENTA IN SITU),
A. G. Andrushaitis, A. K. Avens, and Z. K. A. Seisuma.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 76-81, 1984. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Gulf of Riga, *Baltic Sea, *Ecosystems, *Water analysis, Monitoring, Water quality control, Energy transfer, Sediment transport.

The use of ecological enclosures significantly increases the efficiency of eco-toxicological experiments and studies made of matter and energy transport in water communities. The present state of the art of this method is described along with ways in which it can be improved in the future. An experiment concerning the pollution of controlled ecosystems in the Gulf of Riga (Baltic Sea) is described in detail. A specially constructed 1.5 cubic meter PVC closed system allowed studies to be made of the effect of pollutants on zoo-, phyto- and bacterioplankton in the littoral zone of the Sea. (Author's abstract)
W85-06464

CERTAIN RESULTS OF MUD DEPOSIT FRESHENING IN THE LIMAN SASYK (NEKOTORYE REZUL'TATY OPRESNENIYA ILOVYKH OTLOZHENII LIMANA SASYK),
B. I. Novikov.
Gidrobiologischeski Zhurnal Vol. 20, No. 3, p 70-73. 1984. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Estuarine environment, *Chlorides, *Mud, *Liman Sasyk, Salts, Porous media, Diffusion, Sediments.

Chlorine-ion content in liman muds is studied in the initial period of water freshening. By comparing the results with earlier obtained data and considering the main regularities in salt diffusion in porous media it is shown that the available freshening procedure is not quite efficient and impose no restraints on salt delivery from mud deposits to water masses. (Author's abstract)
W85-06476

MISSISSIPPI RIVER OUTFLOW PATTERNS SEEN BY SEASAT RADAR,
Hawaii Inst. of Geophysics, Honolulu. Planetary Geosciences Div.
L. R. Gaddis, and P. J. Mouginis-Mark.
Geology, Vol. 13, No. 4, p 227-230, April, 1985. 3 Fig, 1 Tab, 15 Ref. NASA grant 956434.

Descriptors: *Mississippi River Delta, *Satellite technology, *Radar, *Waves, Remote sensing, Deltas, River discharge, Coastal areas, Gulf of Mexico.

A new kind of ocean surface feature has been observed on Seasat synthetic aperture radar (SAR) images of the Mississippi River Birdfoot Delta and adjacent Gulf of Mexico waters. Although ocean surface wave patterns have been detected by Seasat SAR in several coastal areas, their origin was attributed to the interaction between oceanic currents and bottom topography. In contrast, no such correlation was found between surface wave patterns and bathymetry at the Mississippi Delta, where the morphometry and distribution of the detected waveforms suggest a river discharge origin. Although contemporaneous data from the Landsat D Thematic Mapper are not available, visible and infrared images acquired at other times generally support this hypothesis; the boundaries of the turbid, cooler river water correspond well to those of the surface wave patterns detected by the Seasat SAR. (Author's abstract)
W85-06519

RESIDUAL CURRENTS IN PORT TALBOT HARBOUR; A MATHEMATICAL MODEL STUDY,
Bristol Univ. (England). Dept. of Civil Engineering.
R. A. Falconer.
Proceedings of the Institution of Civil Engineers, Vol. 79, Part 2, p 33-53, March, 1985. 11 Fig, 21 Ref.

Descriptors: *Port Talbot Harbor, *Wales, *Estuaries, *Mathematical models, *Water currents, Flooding, Coastal waters, Tidal waters, Channels, Harbors, Velocity.

The development and application of a mathematical model to predict the tide induced circulation within a narrow entranced harbor, Port Talbot Harbor, in Swansea Bay, Wales, is described. The harbor experiences exceptionally large spring tidal ranges. The model was specifically developed to

predict the residual circulation, or horizontal secondary currents, in a non-linear flow field and hence particular emphasis was placed on the finite difference representation of the convective accelerations and the shear stress terms. The time centering of the convective accelerations led to a stable finite difference scheme, and the adopted representation of the cross-product accelerations appeared to overcome the occurrence of grid scale oscillations. For the flood tide, the high velocity gradients at the tip and immediately downstream of the main breakwater, the narrow entrance of this particular harbor and the corresponding adverse pressure gradients led to the generation of pronounced secondary currents in the mathematical model. These residual currents persisted well into the ebb tide and were expected to be stronger in the actual harbor than as predicted in the model. The mathematical model appeared to simulate satisfactorily the flooding and drying of shallow areas in Port Talbot Harbor which, for the high spring tides, was relatively extensive at low water. The treatment of the open boundary, which was parallel to the longitudinal axis of the dredged channel, seemed to be relatively unimportant in predicting the velocity field within the harbor. The assumption of a horizontal water surface slope and a normal velocity component only along the open boundary did not appear to give rise to erroneous predictions of the internal velocity field. This non-conservative momentum boundary condition can often lead to erroneous results - particularly when tidal eddies are being simulated. (Baker-IVI)
W85-06578

CHEMICAL COMPOSITION OF AQUATIC VEGETATION IN SOME TYPICAL WETLANDS OF KASHMIR,
Himachal Pradesh Univ., Simla (India). Dept. of Biosciences.
For primary bibliographic entry see Field 2H.
W85-06651

PRODELTA ENVIRONMENT OF A FJORD: SUSPENDED PARTICLE DYNAMICS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Centre.
For primary bibliographic entry see Field 2H.
W85-06698

210PB-DERIVED SEDIMENT ACCUMULATION AND MIXING RATES FOR THE GREATER PUGET SOUND REGION,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2J.
W85-06701

SEDIMENT, SEASON, AND SALINITY EFFECTS ON PHOSPHORUS CONCENTRATIONS IN AN ESTUARY,
Agricultural Research Service, Beltsville, MD.
For primary bibliographic entry see Field 5C.
W85-06727

SIMULATION STUDY OF EUTROPHICATION IN HIROSIHIMA BAY,
Hiroshima Univ. (Japan). Inst. of Environmental Chemistry.
T. Mukai, K. Takimoto, T. Shibata, and H. Abe.
Water Research, Vol. 1, No. 4, p 511-525, 1985. 23 Fig, 2 Tab, 30 Ref.

Descriptors: *Hiroshima Bay, *Japan, *Eutrophication, Particulates, Dissolved solids, Organic matter, Carbon cycle, Model studies, Phytoplankton, Nutrients, Advection, Diffusion.

A phytoplankton model, which includes a carbon cycle combined with a constant current obtained by the computation of tidal curents, was applied to the coastal region of Hiroshima Bay, Japan. The transformation rate constants for the carbon cycle were experimentally evaluated. The modeling approach as developed has several advantages: the transformation rate constants were evaluated in the non-steady state and were described as functions of environmental parameters. Thus it is possible to analyze closely the eutrophication in the coastal region. Information of the grazing of phytoplankton by zooplankton and zooplankton concentration are not directly required for this stimulation study. The rate constants are relatively easy to estimate experimentally using light-dark bottles in comparison with the grazing model, but it is difficult to evaluate the rate constants in winter because of small variations in carbon concentrations. Disadvantages include the estimation of some rate constants being necessary compared with nutrient loading models, and the complexity and expense of the simulation. As detritus is not taken into consideration in the carbon cycle model, this model is a simplified one. Data on detritus are lacking in the coastal region. In general terms, carbon increased by phytoplankton growth was about 10 times carbon augmented by inflow from land at the shore in summer. Sinking plays an important role in the elimination of particulate organic matter. On the other hand, horizontal advection and turbulent diffusion are important factors for the diminution of dissolved organic matter. (Baker-IVI)
W85-06739

SEDIMENTOLOGY AND EVOLUTION OF OHIWA HARBOUR, A BARRIER-IMPOUNDED ESTUARINE LAGOON IN BAY OF PLENTY,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
B. M. Richmond, C. S. Nelson, and T. R. Healy.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 4, p 461-478, 1984. 12 Fig, 7 Tab, 41 Ref.

Descriptors: *Sedimentology, *Estuarine environment, *Lagoons, *Bay of Plenty, *Ohiwa Harbour, *New Zealand, Harbors, Sediments, Bedforms, Tidal flats, Barriers, Sandspits, Benthos.

Ohiwa Harbour is a 24 sq km estuarine lagoon impounded by the 6 km long Ohope spit in the west and the 0.7 km long Ohiwa spit in the east. These barrier sand spits are presently separated by a c. 340 m-wide inlet channel where the maximum harbor depth of 14 m occurs. Seventy percent of the harbor consists of tidal flats supporting a rich shelly benthos and diversified by stands of mangrove and backed locally by salt marsh. Lower harbor sediment in barrier beach, dune and entrance shoal and channel environments are well sorted, negatively-skewed, medium to fine sands. In contrast, upper harbor sediments are poorly to very poorly sorted, positively-skewed, medium to very fine (silty) sands, the coarser of these deposits occurring in channel and restricted harbor beach environments, and the finer in intertidal flat, creek, and channel bank areas. The terrigenous mineralogy is consistent with a dominantly acid volcanic provenance, directly from the tephra mantle of the catchment and, most importantly, indirectly from the oceanic littoral zone. Sediment dispersal is dominated by tidal currents. Speeds decrease systematically up-harbor from maximum values of 100-150 cm/s at the inlet channel to 5-10 cm/s in upper-harbor reaches. Current ripples, megaripples, and sand waves characterize the high energy, current-dominated lower harbour deposits, whereas small-scale current and wave ripples, together with biogenic markings and burrows, characterize the lower energy, inner harbor deposits. Small amplitude, wind-forced waves are important for resuspending and moving sediment in intertidal areas, particularly on the upper tidal flats. Most areas of the harbor are affected by biological processes. Rapid growth of Ohope barrier spit resulted from increased eastwards transport of littoral sands around Whakatane Heads, west of Ohiwa Harbor. The probable cause of this was the infilling of the up-drift Rangitaiki Plains embayment which was essentially completed soon after the time of the Taupo Pumice eruption (AS 131). Over the last 2000 years Ohope spit has accreted laterally eastwards at an average rate of about 3 m/y, Ohiwa spit has concomitantly eroded, and there has been accelerated infilling of Ohiwa Harbour. (Author's abstract)
W85-06798

WIND-RELATED RESUSPENSION OF SEDIMENTS IN THE PEEL-HARVEY ESTUARINE SYSTEM,
Western Australia Univ., Nedlands. Dept. of Soil Science and Plant Nutrition.
J. O. Gabrielson, and R. J. Lukatelich.
Estuarine, Coastal and Shelf Sciences, Vol. 20, No. 2, p 135-145, February, 1985. 3 Fig, 5 Tab, 26 Ref.

Descriptors: *Peel-Harvey Estuary, *Western Australia, *Resuspension, *Wind, Fetch, Waves, Sedimentation, Primary productivity, Estuaries, Suspended sediments.

The Peel-Harvey Estuarine System, located 80 km south of Perth, Western Australia, consists of two large interconnected coastal plain lagoon with a 5 km long, narrow channel connecting it to the ocean. Peel Inlet, 75 sq km, is nearly circular and consists of a central basin and wide peripheral platforms which occupy more than half the total area. Harvey Estuary is a 20 km long lagoon in an inter-dune depression, reaching 2.5 m depth in its central basin. The tidal regime of the system is atypical in that it is dominated by long term changes in sea level which result in water level changes of up to 50 cm over a 5 to 15 day period. Easterly winds are prevalent in summer, punctuated by a reliable sea breeeze which develops about mid-day. In winter the passage of cold fronts over the southern part of the state brings westerly gales and most of the higher velocities are associated with these storms. Resuspension of bottom sediments accounted for 69-92% of the mean deposition rates (11.6 to 69.3 g/sq m/day) measured at 5 sites in the Peel-Harvey Estuarine System. Deposition rates at all but one of the sites were found to be correlated with a function of wind combining a fetch factor with the number of hours of winds greater than 5 m/sec, weighted by the third power of wind velocity. The exception was the only site with a cover of benthic algae during the study. Wind related resuspension greatly affects the forms and amounts of productivity in this system. (Baker-IVI)
W85-06851

OBSERVED FLUXES OF WATER, SALT AND SUSPENDED SEDIMENT IN A PARTLY MIXED ESTUARY,
Institute for Marine Environmental Research, Plymouth (England).
R. J. Uncles, R. C. A. Elliott, and S. A. Weston.
Estuarine, Coastal and Shelf Science, Vol. 20, No. 2, p 147-167, February, 1985. 10 Fig, 1 Tab, 39 Ref. Department of the Environment contract DGR 480/48.

Descriptors: *Estuary, *Salt, *Suspended sediment, *Tamar Estuary, *England, *Circulation, Salinity, Tides, Sediment balance, Water balance, Turbidity.

Residual fluxes of water, salt and suspended sediment were observed at seven stations along the Tamar Estuary (England). The data include measurements over single spring and neap tidal cycles, and are generally applicable to medium or high run-off conditions. Surface to bed differences in salinity are typically of the order of several parts per thousand. Gravitational circulation is an important component of residual flow in the deep, lower reaches of the estuary. Here, Stokes drift is insignificant. In the shallow upper reaches, the major residual currents are generated by Stokes drift and freshwater inputs. Data were compared with predictions from Hansen and Rattray's model of estuarine circulation. Salt fluxes due to tidal pumping and vertical shear are directed up-estuary at spring tides, tidal pumping being dominant. Tidal pumping of salt is also directed up-estuary at neap tides, although it is insignificant in the lower reaches, where vertical shear dominates. Tidal pumping of suspended sediment is directed up-estuary near the head at spring tides, and probably contributes to the formation of the turbidity maximum. The existence of the turbidity maximum was predicted using a simplified model of the transport of water and sediment. The model shows that an additional mechanism for the existence of the turbidity maximum is an up-estuary maximum in the tidal current speeds (and thus resuspension). In the

lower reaches, transport of suspended sediment is directed down-estuary at both spring and neap tides, and sediment is essentially flushed to sea with the fresh water. (Author's abstract)
W85-06852

EFFECTS OF ENVIRONMENTAL GRADIENTS CONCERNING WATER QUALITIES ON THE STRUCTURE OF THE PHYTOPLANKTON COMMUNITY IN THE COASTAL SEA,
Hiroshima Univ. (Japan). Inst. of Environmental Chemistry.
T. Mukai, and K. Takimoto.
Estuarine, Coastal and Shelf Science, Vol. 20, No. 2, p 169-181, February, 1985. 6 Fig, 3 Tab, 17 Ref.

Descriptors: *Coastal water, *Seto Inland Sea, *Japan, *Water chemistry, *Phytoplankton, Water quality, Inland seas, Species diversity, Species composition.

The effects on the structure of the phytoplankton community of in situ water quality gradients formed during mixing of coastal with oceanic waters were investigated over a wide area of the Seto Inland Sea, Japan. As shown by use of the diversity index, the community structure of the phytoplankton varied almost constantly along the in situ environmental gradients. These observations represent the direct or indirect response of the phytoplankton community to environmental gradients which occur in situ and which create a series of variations of the habitat of the phytoplankton community. Their effects were reflected in the structure of the phytoplankton community, not in biomass. It was difficult to establish quantitatively the extent of their effects because of the variability in the degree of the environmental gradients which occur in situ.
W85-06853

COMPARATIVE STUDY OF MERCURY CONTAMINATION IN THE TAGUS ESTUARY (PORTUGAL) AND MAJOR FRENCH ESTUARIES (GIRONDE, LOIRE, RHONE),
Ecole Normale Superieure, Paris (France).
For primary bibliographic entry see Field 5B.
W85-06854

OBSERVATIONS ON THE ECOLOGICAL IMPORTANCE OF SALT MARSHES IN THE CUMBERLAND BASIN, A MACROTIDAL ESTUARY IN THE BAY OF FUNDY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
D. C. Gordon, Jr., P. J. Cranford, and C. Desplanque.
Estuarine, Coastal and Shelf Science, Vol. 20, No. 2, p 205-227, February, 1985. 7 Fig, 7 Tab, 48 Ref.

Descriptors: *Salt marshes, *Marshes, *Cumberland Basin, *Estuaries, *Bay of Fundy, *New Brunswick, *Nova Scotia, Spartina, Species composition, Tides, Primary production, Turbidity, Tidal energy, Carbon.

The Cumberland Basin, a 118 sq km estuary at the head of the Bay of Fundy which has an average tidal range of about 11 m, contains large tracts of salt marsh (15% of the area below highest high water). Low marsh (below about 0.9 m above mean high water) is composed almost exclusively of Spartina alterniflora while the vegetation on high marsh is more diverse but dominated by Spartina patens. Because of its higher elevation, high marsh is flooded infrequently for short periods by only extreme high tides. Low marsh is inundated much more frequently by water as much as 4 m deep for periods as long as 4 h per tide. Temporal variability in the occurrence of extreme tides influences the flooding frequency of high marsh for any given month and year. Using a modification of Smalley's method, the mean annual net aerial primary production (NAPP) of low and high marsh is estimated to be 272 and 172 g C/sq m, respectively. Vegetation turnover times average 1.0 and 2.0 y for low and high marsh, respectively. Because of abundant tidal energy, much of the low marsh production appears to be exported and distributed widely about the estuary. Since high levels of turbidity suppress phytoplankton production, salt marshes produce approximately half of the carbon fixed photosynthetically in the Cumberland Basin. It is concluded that salt marshes play a major ecological role in the Cumberland Basin. (Author's abstract)
W85-06855

MODEL FOR LAKE-BAY EXCHANGE FLOW,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
A. Klapwijk, and W. J. Snodgrass.
Journal of Great Lakes Research, Vol. 11, No. 1, p 43-52, 1985. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Model studies, *Seiches, *Lake Ontario, *Hamilton Harbour, *Great Lakes, *Exchange flow, *Bays, Mathematical models, Stratification, Water transport, Mixing, Dissolved solids.

Transient inflows and outflows of water between Lake Ontario and Hamilton Harbour, driven by lake seiches, can be parameterized as a two-directional exchange flow. Estimates of exchange flows made from current measurements by others result in unlikely values. A model was developed for exchange flow during summer stratification in which two distinct flow patterns exist (i) lake water enters the harbor's hypolimnion, displacing an equal volume of hypolimnetic water to the epilimnion and then of epilimnetic water to the lake and (ii) lake water exchanges directly with the harbor's epilimnion. The temporal variation of exchange flows are estimated from a TDS budget and temperature data. They suggest that weekly estimates of epilimnetic exchange vary from 1 to 5 times Q (the average annual flow rate) while hypolimnetic exchange varies from 0 to 15 times Q for a 3-year period. The calculations suggest that stratification and lake seiches significantly increase the 'pumping' action of exchange flow in summertime compared to the remainder of the year. (Author's abstract)
W85-06864

FRONTAL ZONE ANALYSIS AT THE MOUTH OF A FJORD - JERVIS INLET, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Oceanography.
T. R. Parsons, H. M. Dovey, W. O. Cochlan, R. I. Perry, and P. B. Crean.
Sarsia, Vol. 69, No. 2, p 133-137, 1984. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Jervis Inlet, *British Columbia, *Fjords, *Productivity, *Frontal zones, Zooplankton, Phytoplankton, Primary productivity, Chlorophyll, Temperature, Salinity, Tidal waters.

The entrance to Jervis Inlet, a fjord on the coast of British Columbia, was investigated for the possible presence of a frontal zone. Historical data on tidal exchange was combined with temperature/salinity reports and data collected on a cruise into the inlet during June of 1983. Near-surface fluorescence transects indicate no substantial increase of chlorophyll a in the outer part of Jervis Inlet from Malaspina Strait to Hotham Sound. There was a large increase in the northern past of Agamemnon Channel with a pronounced maximum near its junction with Jervis Inlet. Nitrate concentrations throughout the region were generally below the limit of detection in the uppermost 2 m but increased to about 20 microg-at/l below the pycnocline. Phytoplankton species present at all stations included Skeletonema costatum, Chaetoceros sp., and Noctiluca sp. Zooplankton samples at all six productivity stations were dominated by herbivorous copepods, medusae, siphonophores, ctenophores, and euphausiids. Jervis Inlet differs from Saanich Inlet in not having a frontal zone located at its mouth. The depth at the mouth of Jervis Inlet is about 250 m while that at the mouth of Saanich Inlet is about 50 m. (Baker-IVI)
W85-06876

DELTA13C EVIDENCE OF THE ORIGINS AND FATES OF ORGANIC CARBON IN ESTUARINE AND NEARSHORE FOOD WEBS,
Washington Univ., Seattle. Fisheries Research Inst.
C. A. Simenstad, and R. C. Wissmar.
Marine Ecology, Vol. 22, No. 2, p 141-152, 1985. 5 Fig, 3 Tab, 77 Ref. Washington Sea Grant R/F-37.

Descriptors: *Organic carbon, *Estuarine environment, *Hood Canal, *Puget Sound, *Coastal waters, *Carbon radioisotopes, *Food chains, *Washington, Isotope studies, Fjords, Seasonal variation, Primary production, Inorganic carbon.

Origins and fates of organic carbon in estuarine and nearshore marine food webs of Hood Canal, a fjord extension of Puget Sound, Washington (USA), were evaluated seasonally using stable carbon isotopes (delta C-13). Delta C-13 was measured in: (1) autotrophic sources in terrestrial, estuarine, and nearshore marine habitats; (2) particulate and dissolved organic carbon (POC, DOC) in riverine, estuarine, and nearshore marine waters; (3) primary and secondary consumers in selected estuarine and marine littoral and neritic food webs. Autotrophic sources in terrestrial, riverine, salt marshmeadow, and neritic habitats were generally more C-13-depleted (averaging -30, -26, and -22%, respectively) than sources in estuarine and marine littoral habitats (-8 and -23%). The isotopic composition of neritic consumers indicated that their food sources originated directly from phytoplankton production. In contrast, the delta C-13 of primary and secondary consumers (-11% to -23%) in estuarine and marine littoral habitats suggested that the most important sources of organic carbon to these food webs were autochthonous, originating primarily from eelgrass, epiphytes, and macroalgae. Estuarine detritus deposits, sestonic POC, and sediments had widely ranging delta C-13 values (-9.7 to -28.9%), indicating diverse origins. However, POC associated with surface foam in estuarine littoral waters and DOC in marine littoral waters both had isotopic values most similar to estuarine autotrophs and consumers, suggesting the potential importance of dissolved and foam organics in food-web pathways. Depletion as high as Delta 8% occurred in autotrophs, DOC, and some consumer organisms in estuarine and nearshore marine habitats during winter. This seasonal depletion in delta C-13 originates from variable imports of dissolved inorganic carbon (DIC) transported by freshwater and may reflect the influence of extensive freshwater storage in Hood Canal during fall and winter. These results indicate the need for further elucidation of the complex biological and chemical mechanisms of formation, cycling, and degradation of particulate and dissolved organics from autochthonous sources to estuarine and nearshore marine food webs. (Author's abstract)
W85-06877

OBSERVATIONS OF THE SUSPENDED MATTER DISTRIBUTION DYNAMICS IN THE ELBE ESTUARY FROM TIME SERIES AERIAL PHOTOGRAPHS,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)
R. Doerffer.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 1, p 127-150, 1985. 29 Fig, 20 Ref.

Descriptors: *Suspended matter, *Elbe Estuary, *Germany (Federal Republic), *Time series analysis, Aerial photography, Estuaries, Distribution patterns, Tidal waters.

The suspended matter distribution dynamics in the Elbe River at Luhesand (Federal Republic of Germany) was observed for one tidal cycle using a time series of aerial photographs taken with color film and a wide angle lens. The 1 x 1 km section was mapped from altitudes of 800-1000 m. The sampling interval was about 5-7 minutes for periods of about 1 hour for different phases of the tidal cycle. The images were geometrically corrected with a digital image processing system. The density of the red layer of the film was used as a relative indicator of the suspended matter distribution. The images show complicate patterns in the surface distribution, which are changing during the tidal cycle. Typical features are large fields with an extension of some hundred meters and suspended matter clouds with a typical diameter of about 2-m

as well as long bands caused by ship traffic. The history of a single cloud cannot be traced with the sampling rate of 6 minutes due to fast current velocity and turbulence structure. The distribution structure on the scale of some hundred meters is changing in a different way from the transport of the material forming these structures. A comparison of the distribution with the bathymetry indicates that the topography has the main influence on the small scale local current regime which is on the other hand the main factor determining the distribution and the transport. Another important mechanism, which determines the suspended matter content in the fairway region, is based on the turbulences caused by ship traffic. (Baker-IVI)
W85-06885

EXAMINATION OF TIDAL FLATS, VOL. 2: IDENTIFIED VALUES REVIEW.
Virginia Inst. of Marine Science, Gloucester Point. Available from the National Technical Information Service, Springfield, VA 22161 as PB83-131797, Report No. FHWA/RD-80-182, June 1982. Final Report. Federal Highway Administration, Office of Research, Washington, DC. R.J. Diaz, editor. 47 p, 1 Fig, 2 Tab, 368 Ref.

Descriptors: *Tidal flats, *Evaluation, *Data collections, *Highway effects, *Ecological effects, *Environmental effects, *Wildlife habitats, *Wetlands, Literature review, Habitats, Data interpretation, Waterfowl, Value, Primary productivity, Dredging, Marsh management, Salt marshes.

This report is the second volume of three, documenting a study titled 'Evaluation of Tidal Flat Areas for Highway Planning and Design.' It summarizes the available data from the literature concerning physical, chemical, and biological processes characteristic of the tidal flat environment. Human activities which impact upon the tidal flat environment include dredging and filling, removal of grass beds, recreational and commercial activities, and highway construction. There are a large number of variables involved in evaluating tidal flats. Many of these parameters may act synergistically to create a significantly greater effect than if that variable were considered alone. The evaluation methodology for tidal flat wetlands should rank the salient features of each habitat on a scale of importance values. Features important for ranking are: primary and benthic secondary production, habitat utilization, feeding ground, protective nursery or refuge, shellfish, role in material flow (oxygen, nutrients, pollutants) and waterfowl utilization.
W85-06895

ANIMAL SUBSTRATE RELATIONSHIPS AND PRODUCTIVITY OF INVERTEBRATE MACROBENTHOS OF MISSISSIPPI SOUND AND ADJACENT COASTAL AREAS: A BIBLIOGRAPHY WITH ABSTRACTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. D. Lunz, and H. L. Horstmann.
Miscellaneous Paper EL-81-12, December 1981. Final Report. 143 p, Intra-Army Order FC-81-0020.

Descriptors: *Bibliographics, *Estuaries, *Invertebrates, *Benthos, *Aquatic habitats, *Aquatic animals, Habitats, Mississippi Sound, Aquatic life, Fish, Water quality, Stress, Marine environment.

A bibliography with abstracts and annotations presents information on animal-substrate interaction and benthic invertebrate secondary production relative to the Mississippi Sound and adjacent areas. Other subjects include benthic community pattern classification, the short- and long-term temporal dynamics of benthic faunal communities, benthic pelagic coupling in terms of water quality and pelagic productivity, and benthic responses to stress.
W85-06911

LAKE PONTCHARTRAIN AND VICINITY HURRICANE PROTECTION PLAN; REPORT 1: PROTOTYPE DATA ACQUISITION AND ANALYSIS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2H.
W85-06939

ECOLOGY OF COASTAL WATERS: A SYSTEMS APPROACH,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
K. H. Mann.
Volume 8: Studies in Ecology, University of California Press, Berkeley, CA. 1982. 332 p, 102 Fig, 22 Tab, 594 Ref.

Descriptors: *Coastal waters, *Ecology, *Estuaries, *Ecological effects, *Ecosystems, *Primary productivity, *Ecological processes, Grazing, Predation, Secondary productivity, Detritus, Decomposition, Cycling nutrients.

This book presents a synthesis of current knowledge of the ecological processes occurring in coastal waters worldwide, focussing on the large-scale processes that affect organisms or populations, rather than on the individual organisms or populations themselves. The processes discussed include primary production, grazing, predation, secondary production, detritus formation, decomposition, energy flow, nutrient cycling, and so on, for which the principles involved are enunciated and key references given. The author has concentrated on recent work, producing a book for professionals in research and management.
W85-06945

USER GUIDE FOR CE-QUAL-ELV2: A LONGITUDINAL-VERTICAL, TIME-VARYING ESTUARINE WATER QUALITY MODEL,
Edinger (J.E.) Associates, Inc., Wayne, PA.
E. M. Buchak, and J. E. Edinger.
Instruction Report EL-82-1, December 1982. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 101 p, 5 Fig, 2 Tab, 22 Ref, 8 Append. Contract/Grant No. P.O. DACW39-81-M-2788.

Descriptors: *Model studies, *Computer models, *Estuaries, *Water quality, Fortran, *Computer programs, *Turbulent flow, *Tidal effects, Hydrologic models, Mathematical models, Simulation analysis, Mathematical studies, Models, Mathematical equations, Wind tides.

This report is the user guide for a FORTRAN program that permits time-varying hydrodynamic and transport simulations of estuaries. It also includes a summary of the development of this program, with emphasis on the characteristics of estuaries, estuarine boundary conditions, turbulence, and validation tests. CE-QUAL-ELV2, an acronym for the Estuarine Longitudinal-Vertical 2-Dimensional model, consists of the original Laterally Averaged Estuary Model (LAEM) plus the Water Quality Transport Module (WQTM). The LAEM program was developed for a test application to the Potomac Estuary from the then-current version of the Laterally Averaged Reservoir Model (LARM). The References section of this report lists all the available documents describing the related development of the LARM and LAEM programs. This report contains an overview of the capabilities of CE-QUAL-ELV2; a summary of its theoretical foundation and a discussion of the validation tests; a synopsis of estuarine characteristics, including turbulence, with reference to the Patuxent Estuary; and a detailed discussion of the application procedure, again with reference to the Patuxent example. The appendices contain an input data description with examples and user notes for two auxiliary codes. (Author's abstract)
W85-06957

OBSERVATIONS OF CURRENTS AND WATER PROPERTIES IN COMMENCEMENT BAY,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
G. A. Cannon, and M. W. Grigsby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-108795. NOAA Technical Memorandum OMPA-22, August 1982. 37 p. 19 Fig, 1 Tab, 6 Ref.

Descriptors: *Bays, *Water currents, *Water properties, *Sediment transport, *Water metering, Water measurement, Water analysis, Washington.

Observations of currents and water properties have been made in Commencement Bay, Washington, to provide background information which would be useful in describing physical transport processes in the Bay, and hence, the fate and effect of any dissolved and suspended contaminants. Observations were made during low river runoff commencing in March 1980 and during a higher runoff period commencing March 1981 using moored subsurface current meter arrays and CTD surveys. Each survey entailed shipboard water property measurements for about three days during deployment of the current meter arrays. The arrays provided additional water property and current measurements continuously for approximately sixty days. This data report includes a description of the experiments and representative data presentations. It is intended to provide relatively quick dissemination of the observations for those with special needs. Additional analyses and interpretations will be made at a later time.
W85-06959

BALTIMORE HARBOR AND CHANNELS DEEPENING STUDY; CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 6G.
W85-06968

EXPERIMENTAL INVESTIGATION OF INTRUSIVE GRAVITY CURRENTS ENTERING STABLY STRATIFIED FLUIDS,
Karlsruhe Univ. (Germany, F.R.). Sonderforschungsbereich Ausbreitungs- und Transportvorgaenge in Stroemungen.
For primary bibliographic entry see Field 2H.
W85-07028

BEHAVIOUR OF DISSOLVED IODINE IN THE UPPER ST. LAWRENCE ESTUARY,
Centre Champlain des Sciences de la Mer (Quebec).
For primary bibliographic entry see Field 2K.
W85-07036

CONTROL BY ORGANIC COATINGS OF THE SURFACE CHARGE OF ESTUARINE SUSPENDED PARTICLES,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
T. C. Loder, and P. S. Liss.
Limnology and Oceanography, Vol. 30, No. 2, p 418-421, March, 1985. 2 Fig, 15 Ref. National Environment Research Council grant GR3/3164.

Descriptors: *Organic coatings, *Surface charge, *Suspended particles, *Particulate matter, Electrophoretic mobility, Charge, Iron, Seawater, Salinity.

The electrophoretic mobility (U sub E), and hence the surface charge, of suspended particles from a wide variety of estuaries has been reported to be always negative and to fall in the range -0.7 to -2.0 x 10 to the -8th power sq m/s/V; similarly, U sub E measurements on suspended particles from fresh and seawater also indicate negatively charged particles with U sub E values in a somewhat narrower range than that given above for estuarine particles. This uniformity is often attributed to the presence of organic or oxide surface coatings on the particles. Iron oxide particles formed in situ in organic-free water exhibit the expected positive charge but, on immersion in water containing its natural organic material, rapidly acquire the negative change normally found for field samples. When whole natural samples (water plus suspended particles) were photooxidized with ultraviolet radiation and the organic matter was broken down, U sub E for all suspended particles became more positive. The

breakdown of organic coatings leads to more positive values for U sub E in these iron rich samples. (Collier-IVI)
W85-07073

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SOLAR DESALINATION,
A. A. Delyannis, and E. Delyannis.
Desalination, Vol. 50, p 71-81, October/November, 1984. 2 Fig, 27 Ref.

Descriptors: *Water supply development, *Desalination, *SOLERAS Project, *Solar energy, Reverse osmosis, Distillation, Energy, Solar ponds, Economic aspects.

An analysis is given of the characteristics and operation of conventional solar stills. The potential use of solar ponds is discussed. Recent trends in combining solar energy collection with other processes, such as MSF-distillation and reverse osmosis, are outlined. A brief description is offered of the SOLERAS project. Solar desalination exhibits a considerable economic advantage over other seawater distillation processes, because of cost-free energy and reduced operating costs. Another advantage of the process is its simplicity, as no moving parts are involved. The output of a solar still can only be increased either by increasing the water evaporating surface or the overall efficiency. The overall efficiency of a solar desalting unit is often determined by the ratio of product condensate to the theoretical amount of salt water expected to vaporize, the ratio of the heat of evaporation of the distillate to the solar heat reaching the apparatus. The operating efficiency of a solar still increases exponentially with increasing brine temperature, but heat losses increase in the same way. The productivity of a solar still expresses the amount of distillate produced per unit area of the water surface. There are two ways of increasing the fresh water yield from standard greenhouse distillation units: rain collection; and the use of preheated water or waste hot water as the feed. Direct or indirect use of solar energy may also be combined with other desalination processes, without necessarily having the production of hot water as an intermediate stage. Wind energy to produce electricity or photovoltaics may be combined with reverse osmosis or electrodialysis. (Baker-IVI)
W85-06690

DESALINATION BY THE SALINE WATER CONVERSION CORPORATION OF SAUDI ARABIA,
Saline Water Conversion Corp., Riyadh (Saudi Arabia).
A. M. Al-Golaikah.
Desalination, Vol. 50, p 83-86, October/November, 1984. 1 Tab.

Descriptors: *Water supply development, *Desalination, *Saudi Arabia, Seawater, Drinking water, Water supply, Water demand, Water management, Planning.

The shortage of water has greatly influenced life on the Arabian Peninsula. In 1928, two distillation plants were imported to alleviate a serious water shortage in Jeddah. In 1942 a group of US technologists was brought in to do an overall survey of Saudi Arabia's resources and needs. A five-year development plan for the Kingdom began in 1975 and included some huge projects for desalinating seawater to meet the needs of existing coastal Saudi Arabian cities, as well as new communities and industrial centers along the coasts. In the East, along the Arabian Gulf, desalination plants now extend from Al-Khafji in the uppermost Northeastern corner, to Al-Khobar. Lying between Al-Khafji and Al-Khobar is Al-Jubail, site of the largest desalination plant in the world. Saudi Arabia is clearly the world's largest producer of potable water from the sea. (Baker-IVI)
W85-06691

DEVELOPMENT OF DESALINATION IN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Chemical and Wood Technology.
B. A. Bolto.
Desalination, Vol. 50, p 103-114, October-November, 1984. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Desalination, *Australia, *Seawater, *Water supply development, Reviews, Distillation, Magnetic dealkalization, Sirotherm desalination, Ion-exchange processes, Sirofloc clarification, Economic aspects.

There has been a long established need for augmenting water supplies in Australia, such as by desalination of brackish surface or groundwater and of seawater. Progress in the installation of desalination plants is reviewed, and the future of the technology discussed. The technology is developing on two fronts: large-scale installations associated with industrial developments and salinity control schemes aimed at maintaining the quality of existing surface waters, and smaller-scale installations using existing marginal or brackish water resources to provide potable water in regions lacking adequate fresh water. Until 1975 more than half the desalting units established in Australia were based on distillation of seawater. Generally the plants are to provide drinking water for communities involved with petroleum exploration, mining, or tourism. Since 1975 only one-fifth of the plants established have relied on distillation, usually with seawater as the feed, as reverse osmosis has become more and more accepted for producing potable quality water from brackish groundwater. New techniques being investigated in Australia include the use of magnetic dealkalization, Sirotherm desalination (an ion-exchange process which uses hot water rather than chemicals as the regenerant and has distinct advantages in terms of operating costs, energy requirements and effluent disposal), and Sirofloc clarification, which is an extention of the magnetic particle technology to remove turbidity and color. Economic aspects of desalinization are considered briefly. (Baker-IVI)
W85-06693

REVERSE OSMOSIS MEMBRANE RESEARCH IN CHINA,
Academia Sinica, Dalian (China). Dalian Inst. of Chemical Physics.
L. Zheng.
Desalination, Vol. 50, p 115-124, October/November, 1984. 3 Tab. 85 Ref.

Descriptors: *Desalination, *China (People's Republic), *Reverse osmosis, *Membranes, Reviews, Ultrafiltration, Membrane processes.

The main achievements of reverse osmosis (RO) membrane research and the application of these membranes in the People's Republic of China are discussed. Reverse osmosis equipment and ultrafiltration membranes are also discussed. In 1970 the influence of the molecular weight of cellulose acetate (CA) on membrane performance was investigated. Three types of membranes made from Eastman CA and from Chinese CA materials were compared. The CA membrane was first used for desalination of seawater and brackish water. Among the aromatic nitrogen-containing RO membrane materials, only aromatic polyamide type material has been investigated in China. Ten polyamide materials with different viscosities and molecular weight distributions were studied in 1973. A study of the structural characteristics of an aromatic polyamide type asymmetric RO membrane formed from heated and evaporated casting solutions, using an electron microscope, showed micelles to be a significant characteristic. Other studies investigated the evaporation and gelation of DP-1 membranes and the composition of the casting solution and conditions for the preparation of the membranes. In 1975 a study was made of antioxidation of aromatic polymide RO membranes using an aromatic polyamide membrane with a sulfone group in the polymer main chain. The strongly acidic ionic sulfonated polysulfone RO membranes, possessing excellent anti-acid, antibase and anti-bacterial properties have been studied in China since 1978. More recent research has investigated ultrathin layer composite RO membranes. (Baker-IVI)
W85-06694

STUDY OF COMBINED ACID/ADDITIVE SEAWATER FEED TREATMENT,
Cox, Cannizzaro and Associates, Inc., Centerport, NY.
B. Cox.
Desalination, Vol. 51, No. 2, p 149-162, 1984. 3 Fig, 10 Tab, 6 Ref.

Descriptors: *Desalination, *Seawater, *Additives, *Distillation, Corrosion control, Scale control, Water supply development.

A new hybrid chemical treatment of the seawater feed for MSF distillation plants is described. The advantages and disadvantages of various scale control techniques are discussed along with the details of combined treatment and its huge economic potential. The hybrid acid/additive seawater feed treatment described can be applied beneficially to any MSF plant. If the existing plant operates at 90 degrees C with polyphosphate, use of the high pH hybrid treatment will increase the output by 64%, reduce unit water costs by one-third, eliminate the need for acid cleaning, and protect the plant from corrosion. If the existing plant operates at 112 degrees C using a high temperature polyelectrolyte, use of the hybrid treatment will increase water production by 22% and reduce unit water costs by 13%. It will also eliminate the need for acid cleanings and will protect the plant from corrosion. If the existing plant operates at 121 degrees C using acid treatment, changing to the hybrid treatment will permit continued high temperature operation with tremendously reduced corrosion and plant maintenance. Plant life will be doubled or trebled. If the plant is in the design stage, designing for the use of the hybrid treatment will reduce capital costs 35% compared to polyphosphate, and 16% compared to high temperature polyelectrolyte, as well as greatly reducing operating costs. (Baker-IVI)
W85-07092

FIELD TRIAL OF REVERSE OSMOSIS IN THE EL KHANKA DESERT, EGYPT,
National Research Centre, Cairo (Egypt).
M. G. A. Khedr, A. H. Abd El Wahab, J. Kaschemekat, and J. Mohn.
Desalination, Vol. 51, No. 2, p 173-181, August, 1984. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Desalination, *Reverse osmosis, *El Khanka Kaliobia, *Egypt, Cellulose acetate membranes, Membrane processes, Bentonite, Stabilization, Hyperfiltration.

Installation and operation of a reverse osmosis test facility at El Khanka Kaliobia, Egypt has been undertaken. The test plant is a plate system of nominal output of 45 cu m/day, and has been in operation since January 1979. The results of the first three years of operation are considered. Two prototype reverse osmosis modules were tested, the G3 module during the first phase and the G4 module during the second phase. The two types of membranes used were a blend cellulose di- and triacetate membrane and a bentonite-stabilized cellulose acetate membrane. The trial showed that hyperfiltration units having flat plate modules of medium capacity can be successfully used for the treatment of local brackish water in industrial sites in the desert to produce fresh water for drinking and industrial purposes. Mechanical and desalting efficiency of bentonite-stabilized cellulose acetate membranes combined with periodic chemical washes in long term operation is proven. (Baker-IVI)
W85-07093

PERFORMANCE OF MULTIPLE EFFECT DIFFUSION STILLS,
King Abdulaziz Univ., Jeddah (Saudi Arabia).

Dept. of Mechanical Engineering.
M. M. Elsayed, K. Fathalah, J. Shams, and J. Sabbagh.
Desalination, Vol. 51, No. 2, p 183-199, August, 1984. 12 Fig, 2 Tab, 7 Ref.

Descriptors: *Diffusion stills, *Mathematical models, Conductivity, Desalination, Diffusion, Distillation, Temperature effects.

Experimental testing of a three-effect diffusion still is carried out. The experiment is designed to test the effect of the heating fluid temperature input to the still, Th, and the feed rate of desalinated water to the still F on the performance of the still. The results produced several empirical relations to predict the following in terms of the Th and F: the average temperature of each effect, the rate of distillate produced by each effect, and the performance ratio of the still. In addition, a mathematical simulation is given for the n-effect diffusion still. The mathematical model is verified by comparing its results with the experimental results of the three-effect diffusion still. The model is further used to predict the performance of a ten-effect diffusion still at the following parametric conditions: various values of the dimensionless parameters N3 and N4, various heating medium temperatures input to the still, and various feed rates to the still. The increase in the feed rate to the still reduced the performance ratio. The variations of the dimensionless numbers N3 and N4 had a negligible effect on the performance ratio of the still. The increase in the heating water temperature and/or the decrease in the cooling water temperature improves the performance ratio of the still. (Baker-IVI)
W85-07094

CELLULOSE TRIACETATE MEMBRANES FOR SEAWATER DESALINATION,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
S. V. Josh, and A. V. Rao.
Desalination, Vol. 51, No. 3, p 307-312, September, 1984. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Desalination, *Cellulose triacetate membranes, *Membrane processes, Reverse osmosis, Membranes.

The aim of this study was to obtain a clear, gel- and fiber-free solution of suitable cellulose triacetate (CTA) concentration, to obtain perfect, reproducible membranes without pinholes, and to obtain a membrane for higher rejection for seawater. Several casting formulations were detailed and the necessary proportions of each component are worked out from the observations. Experimental data on reverse osmosis using a sodium chloride solution by CTA membranes are presented. The investigation involved studies on the composition of membrane casting solutions and their effects on the performance. A higher polymer concentration (11-13%) is found suitable for production of a uniform and highly salt rejecting membrane. Salt rejection of 99.0% and 4-5 GFD product water flux were obtained at 1000 psi operating pressure using 30,000 ppm total dissolved solids, seawater in the initial experiments. Proper control over these two parameters is primarily important for evaluating high salt rejection membranes. (Baker-IVI)
W85-07096

3B. Water Yield Improvement

HYDRAULIC TECHNIQUE FOR DESIGNING SCAVENGER-PRODUCTION WELL COUPLES TO WITHDRAW FRESHWATER FROM AQUIFERS CONTAINING SALINE WATER,
Geological Survey, San Juan, PR. Water Resources Div.
A. Zack, and R. Munoz-Candelario.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157725/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, Puerto Rico Water Resources Research Institute, Mayaquez, Sept 1984. 50 p, 20 Fig, 3 Ref, Project No. OWRT A-075-PR (1), Contract/Grant No. 14-34-0001-2141.

Descriptors: *Combination wells, *Saline water, Hydraulic design, Well hydraulics, Well yield, Well water, Coastal aquifers, *Puerto Rico, Saline-freshwater interfaces.

Aquifers in coastal areas of Puerto Rico often contain very limited quantities of freshwater, occurring as a thin lens at the surface of the water table. Many wells have been abandoned because they were inadvertently screened in saltwater parts of the aquifer. It was found in this study that scavenger-production well couples installed in abandoned wells, screened in both fresh and saltwater parts of the aquifer, provided an effective method for extracting only the freshwater from the well. Withdrawing a sufficient quantity of low-chloride water using the couple depended upon the degree of upward movement of saltwater within the aquifer when the well was pumped. Vertical saltwater movement depended upon the relative concentrations of chloride in the borehole and the distribution of horizontal and vertical hydraulic conductivity of the aquifer. The results show that for any well screened in an aquifer containing both freshwater and saltwater, there exists a family of curves representing all combinations of pumping rates and corresponding chloride loads for the scavenger well and the production well pumping simultaneously from the well. The curves are derived empirically by splitting the total chloride load withdrawn from a well into the individual loads production and scavenger wells at various pumping rates. The curves developed permit the optimization of freshwater withdrawals based on pumping desired rates and levels of chloride concentration required for each well. The techniques can be applied to any other wells which exhibit radial flow and maintain the same well efficiency over a wide range of pumping rates.
W85-06316

DEVELOPMENT OF A COMPREHENSIVE UPPER COLORADO RIVER BASIN MODEL FOR ANALYZING ENERGY DEVELOPMENT IMPACTS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 4A.
W85-06323

DEVELOPMENT OF A PREDICTIVE IRRIGATION SCHEDULING INDEX USING ELECTROPHYTOGRAMS,
Arizona Univ., Tucson. Dept. of Electrical Engineering.
For primary bibliographic entry see Field 3F.
W85-06326

CHANGE IN THE HYDROPHYSICAL PROPERTIES OF PEAT-BOG SOILS AFTER APPLICATION OF HYDROLYZED POLYACRYLONITRILE,
Akademiya Navuk BSSR, Minsk. Peat Inst.
I. I. Lishtvan, A. A. Terent'yev, A. I. Sorokin, A. M. Abramets, and V. S. Brezgunov.
Soviet Soil Science, Vol. 16, No. 5, p 116-121, September/October, 1984. 4 Tab, 16 Ref. Translated from Pochvovedeniye, No. 9, p 123-127, 1984.

Descriptors: *Soil properties, *Soil water, *Polyacrylonitrile, *Peat, Water content, Physicochemical properties, Moisture content, Bogs, Soil physical properties, Soil conditioners.

The effect of hydrolyzed polyacrylonitrile (HPAN) on the hydrophysical properties, structure, and biological activity of Peat-Bog soils was studied in the field. To study the effect of HPAN on moisture distribution in the upper soil horizons, the soil was sampled periodically during the season from the 0- to 20-cm layer. The results of the field tests confirmed the efficacy of HPAN as a conditioner for Peat-Bog soils. The macrostructure of the soil remained water stable during the entire growing period and the conditioning effect of HPAN was greater in seasons with less rain because of the lesser leaching of the polymer by rainwater and its lesser migration into the depth of the soil. The stability of the water-stable structure of Peat-Bog soils during the season after application of HPAN depended on the crop grown. This was associated with the number of mechanical soil cultivations that mix the upper soil layers. Small amounts of HPAN (60 kg/ha) had an effect in the field which was approximately the same as that of larger amounts. The addition of 500 kg HPAN/ha did not produce any significant increase in the content of water stable fractions in the soil. The method of application and soil-surface preparation also influence the effect of HPAN as a soil conditioner. In addition to affecting the hydrophysical properties of Peat-Bog soils, HPAN also reduces their biological activity. (Baker-IVI)
W85-06752

STIROMAL, A NEW EFFECTIVE SOIL STRUCTURING AND HYDROPHOBIZING AGENT,
O. A. Agafonov, A. D. Akbasova, I. A. Katicheva, I. A. Romanov, and O. G. Us'Yarov.
Soviet Soil Science, Vol. 16, No. 5, p 122-125, September/October, 1984. 2 Fig, 3 Tab, 5 Ref. Translated from Pochvovedeniye, No. 4, p 109-112, 1984.

Descriptors: *Soil water, *Moisture availability, *Evaporation control, Aggregates, Irrigation, Erosion control, Soil properties, Soil conditioners.

The possibility of using hydrolyzed stiromal to produce water-resistant aggregates and serve as an evaporation suppressor is discussed. Positive results were obtained in Sod-Podzolic soils and Solonetzes. Two clay loam soils, a sod-Prozolic soil and a Solonetz were treated with the compound in solution. The technical effectiveness of hydrolyzed stiromal (a copolymer of styrene and maleic anhydride) when used to treat the soils was equivalent to that of the best-known conditioners; the optimum amount is 0.05%. The given agent sharply decreases the rate and height of the capillary rise of water and reduces evaporation from the soil regardless of the humidity of the air. It may be effective in controlling unproductive losses of moisture through evaporation, soil crusting, and water, wind and irrigation erosion. A high calcium chloride content in the soil decreases its effectiveness. (Baker-IVI)
W85-06753

PUTTING WASTEWATER TO WORK,
El Paso, TX.
For primary bibliographic entry see Field 3D.
W85-06816

3C. Use Of Water Of Impaired Quality

IRRIGATION WITH BRACKISH WATER UNDER DESERT CONDITIONS; I. PROBLEMS AND SOLUTIONS IN PRODUCTION OF ONIONS (ALLIUM CEPA L.),
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Applied Research Inst.
D. Pasternak, Y. De Malach, and I. Borovic.
Agriculture Water Management, Vol. 9, No. 3, p 225-235, November, 1984. 3 Fig, 7 Tab, 11 Ref.

Descriptors: *Onions, *Brackish water, *Irrigation water, Crop production, Deserts, Electrical conductivity, Sprinkler irrigation, Drip irrigation, Crop yield.

To identify the problems and suggest solutions for onion production under brackish water irrigation in a desert environment, a series of trials with brackish water (electrical conductivity, ECi = 4.4 dS/m) and fresh water ECi = 1.2 dS/m) was conducted, using both sprinkler and drip irrigation systems. Under sprinkler irrigation with brackish water the mean electrical conductivity of the saturated soil extract (ECe) was about 6.0 dS/m and the yield reduction was 60%. With drip irrigation, the ECe under the drippers was about 5.0 dS/m and the yield reduction was 30%. Sprinkler irrigation affected yield through a reduction in both bulb size and bulb number per unit area. Drip irrigation affected the bulb number only. In the latter system seedling death occurred during the first 40 days

following field emergence. Yield reduction was completely prevented by germinating and establishing the field with freshwater irrigation before transferring to brackish water irrigation, 45 days after sowing. With the sprinkler system, onion yield with brackish water irrigation could be increased by either increasing the sowing density or by alternating between brackish and freshwater irrigation. (Author's abstract)
W85-06282

SALINE COOLING TOWER WATER FOR IRRIGATION IN MINNESOTA: I. CROP AND SOIL EFFECTS,
Montana Agricultural Experiment Station, Huntley, MT. Southern Agricultural Research Center.
R. E. Engel, G. L. Malzer, and F. G. Bergsrud.
Journal of Environmental Quality, Vol. 14, No. 1, p 32-36, January/March, 1985. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Cooling water, *Saline water, *Irrigation water, *Minnesota, Corn, Alfalfa, Soil water, Soil solution, Salinity, Rainfall, Leaching, Sulfates, Electrical conductivity, Calcium, Magnesium.

Saline cooling tower water (CTW) from the Northern States Power coal-fired plant in Sherburne County, MN was used to irrigate a Hubbard loamy sand (Udorthentic Haploboroll). The objectives of this study were to determine the changes in soil solution salinity, to measure salt accumulations in the soil profile (0- to 240-cm), and to assess the impact of CTW on crop production. In a 3-yr field study, CTW (2.2 dS/m) was applied at two rates to alfalfa (Medicago sativa L.), corn (Zea mays L.) and fallow areas. Analysis of the soil water for electrical conductivity (ECSW) at 75 cm indicated that an increase in salt concentration occurred over the growing season. Maximum seasonal ECSW at 75 cm in the cropped areas (3.0-4.0 dS/m) were higher than in the fallow areas (2.0-2.5 dS/m). Rainfall between the growing seasons, however, was adequate to leach the upper 75 cm of this coarse-textured soil and prevent a stepwise buildup of salts from one year to the next. After an initial buildup, ECSW at 225 cm was relatively stable. For the last 2 yr, ECSW at 225 cm was consistently higher under alfalfa than corn or fallow areas. A seasonal buildup of SO4 occurred during the growing season. In the fall, SO4 accumulations in the 0- to 60-cm soil layer were highest under corn. By the following spring, there was no difference between the three cropping systems. Rainfall was very effective in leaching seasonal accumulations of SO4 from the soil. A lower Ca/Mg ratio in the CTW, as compared with the soil, resulted in increased concentration of Mg in the 0- to 60- and 60- to 150-cm soil layers. Corn grain and alfalfa production averaged 8440 and 8230 kg/ha for the last two seasons, respectively, and were not adversely affected by salinity produced from the CTW application. (Author's abstract)
W85-06615

SALINE COOLING TOWER WATER FOR IRRIGATION IN MINNESOTA: II. DRAINAGE WATER COMPOSITION, LEACHING FRACTION, AND EFFECT ON AQUIFER QUALITY,
Montana Agricultural Experiment Station, Huntley, MT. Southern Agricultural Research Center.
R. E. Engel, G. L. Malzer, and F. G. Bergsrud.
Journal of Environmental Quality, Vol. 14, No. 1, p 36-40, January/March, 1985. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Irrigation water, *Saline water, *Drainage water, *Leaching, *Minnesota, Cooling water, Groundwater pollution, Alfalfa, Corn, Calcium, Sulfates, Aquifer.

Saline cooling tower water (CTW) from the Sherburne County electrical power plant in Minnesota is being considered as an irrigation water source on surrounding croplands. Since the soils are coarse-textured and this region receives an average 66 cm rainfall annually, salt will leach into the underlying aquifer. This study was undertaken to determine composition of drainage waters, leaching fractions (LF), and quality of the underlying aquifer (10-12 m) as affected by irrigation with CTW at two rates under three cropping systems. In a 3-yr field study (1979-1981), alfalfa (Medicago sativa L.), corn (Zea mays L.), and fallow plots were irrigated at rates that replaced net water deficits (I1) and twice the net water deficits (I2) in the cropped areas. The soil at this site was a Hubbard loamy sand (Udorthentic Haploboroll). Lysimeters, 57 cm in diam., were buried 150 cm below tile plots to monitor the composition of the drainage waters and to determine the LF. Wells were installed in all plots to monitor deep movement of the CTW salts into the aquifer. Application of CTW increased the concentration of Ca and SO4 in the drainage waters. These ions together comprised 70-75% of the total ion equivalents measured. Salt concentrations were generally higher under alfalfa than corn and fallow, reflecting its higher water requirement. Drainage waters were undersaturated with respect to gypsum; thus, SO4 added from the irrigation water stayed in solution. The LF under the I2 rate averaged 0.58. The LF under the alfalfa and corn (I1 rate) averaged 0.34 and 0.38, respectively. The LFs under the I1 rate were higher than anticipated. Apparently, even when irrigation was scheduled at a rate consistent with satisfactory crop growth, a considerable amount of water - and in turn salts - were lost from the soil profile due to heavy, erratic precipitation. Salt concentrations in the aquifer increased greatly over the 3 yr. Sulfate concentrations peaked at 6.4 mmol/L in 1981, over 20 times greater than background levels and higher than U.S. Environmental Protection Agency drinking water standards. (Author's abstract)
W85-06616

3D. Conservation In Domestic and Municipal Use

MUNICIPAL DEMAND FOR WATER IN KUWAIT: METHODOLOGICAL ISSUES AND EMPIRICAL RESULTS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6D.
W85-06497

PUTTING WASTEWATER TO WORK,
El Paso, TX.
J. W. Rogers.
EPA Journal, Vol. 11, No. 3, p 5-6, April, 1985. 2 Fig.

Descriptors: *Water conservation, *El Paso, *Texas, *Water supply development, *Wastewater treatment, Water recirculation, Sewage, Water treatment, Drinking water.

El Paso, Texas becomes this year the first large community in the United States to stretch its dwindling water resources by pumping reprocessed sewage into its major underground aquifer. Over 65% of the city's water is taken from this aquifer. A grant of $20.5 million was obtained from the EPA to pay part of the $32 million total cost of plant construction. The treatment system uses biological and activated carbon processes to remove all organic and nitrogen compounds. Operating costs are projected at 85 cents per thousand gallons and is well within the range of water charges under El Paso's graduated water rate system. The city also has an effective program to reduce individual water consumption. The water rate structure includes a five step increasing rate for residential customers and a three step increasing rate for all other customers. Concrete ground storage reservoirs are lined with plastic to reduce the water loss and eight to 10 miles of deteriorated water lines are replaced each year. These and other conservation measures have reduced water use from 216 gallons per person per day in 1977 to 185 gallons in 1984. (Baker-IVI)
W85-06816

3F. Conservation In Agriculture

EFFECT OF FURROW DIKING, SUBSOILING, AND SLOPE POSITION ON CROP YIELDS,
Texas Agricultural Experiment Station, Vernon.
C. J. Gerard, P. D. Sexton, and D. M. Conover.
Agronomy Journal, Vol. 76, No. 6, p 945-950, November-December, 1984. 5 Fig, 9 Tab, 10 Ref.

Descriptors: *Furrow diking, *Subsoiling, *Slope, *Crop yield, *Texas, Sorghum, Cotton, Runoff, Water conservation.

The effects of furrow diking and subsoiling on runoff and crop yields were evaluated on gently sloping land in the Rolling Plains of Texas. Diking and subsoiling reduced runoff and significantly increased yields of sorghum (Sorghum bicolor (L.) Moench) and cotton (Gossypium hirsutum L.). Yields of diked sorghum and cotton were 108 and 32% higher than the check, respectively. Yields of sorghum on the diked treatment on an Abilene loam soil (fine, mixed, thermic Pachic Argiustoll) averaged about 2550, 3300, and 3590 kg/ha or about 302, 140, and 42% more than the check treatment on the upper, middle, and lower parts of the slope, respectively. In contrast, cotton yields on the diked treatment on a Miles fine sandy loam soil (fine-loamy, mixed, thermic udic Paleustalf) averaged about 465, 515, and 475 kg/ha or about 57, 37, and 11% more than the check on the upper, middle, and lower parts of the slope, respectively. Response to subsoiling varied with years and crops. Results show that a determinant crop such as sorghum is more critically affected by loss of water due to runoff than the less determinant cotton crop. These studies show that furrow diking is effective in reducing runoff and increasing crop yields and that location on the slope has a significant effect on yields. (Author's abstract)
W85-06186

EFFECTS OF REGULATED WATER DEFICITS ON PEAR TREE GROWTH, FLOWERING, FRUIT GROWTH, AND YIELD,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
P. D. Mitchell, P. H. Jerie, and D. J. Chalmers.
Journal of the American Society of Horticultural Sciences, Vol. 109, No. 5, p 604-606, September, 1984. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Irrigation practices, *Plant growth, *Crop yield, *Water deficit, *Pear trees, Flowering, Evaporation.

Three levels of water deficit generated by 3 levels of irrigation applied at times of rapid vegetative growth and/or slow fruit growth were compared to determine their suitability for restricting vegetative growth on 5 year old Bartlett pear trees trained to a Tatura Trellis. For the period of Regulated Deficit Irrigation (RDI), the amount of water applied replaced 92%, 47%, and 23% of the evaporation calculated over the planting square (Eps). In the subsequent period of rapid fruit growth until harvest, all trees were irrigated with 150% Eps to ensure that the wetting pattern from the trickle system wetted the entire root zone. Additional water increased vegetative growth. RDI did not decrease final fruit size or yield. Blossom density was increased in the following spring by RDI with flower clusters/sq cm of limb cross sectional area of 2.39, 2.01, and 1.36 respectively on the 0.23, 0.46 and 0.92 Eps treatments. The effect of RDI on blossoming also has major practical implications. The pear trees in this experiment had entered a biennial bearing habit, and blossom density was increased in the off-season. Close investigation of RDI is warranted on species and cultivars with pronounced biennial characteristics. (Baker-IVI)
W85-06204

APPLE ROOT DISTRIBUTION AS EFFECTED BY IRRIGATION AT DIFFERENT SOIL WATER LEVELS ON TWO SOIL TYPES,
Department of Agriculture, Potchefstroom (South Africa).
D. J. Beukes.
Journal of the American Society of Horticultural Sciences, Vol. 109, No. 5, p 723-728, September, 1984. 4 Fig, 4 Tab, 7 Ref.

Descriptors: *Soil water, *Irrigation effects, *Apple trees, *Roots, Density, Soil types, Plant growth, Water stress, Soil water depletion.

Apple trees were grown in a field trial at soil water depletion (SWD) levels of 15% (wet) and 75% (dry). Water extraction depths were divided into 3 or 4 depth increments, and ranged from 700 to 1100 mm, depending on the treatments and rooting depth. Treatments were applied from the end of shoot extension growth until harvest. In a loamy sand and a loam soil, root distribution was affected primarily by the soil water regime. Irrigation at different depletion levels had little effect on root diameter distribution for the Dundee form. After 3 years the 0-600 mm loamy sand soil layer contained 88.0% of the roots for the 15% SWD (wet) and 57.7% for the 75% SWD (dry) levels. After 2 experimental seasons, the majority of roots were concentrated in the top 600 mm of soil for the wet treatment. In contrast, under dry treatment, root development extended down to 1100 mm but density decreased. In the loam soil series in the 0-600 mm soil layer the wet treatment gave the higher concentration of roots of the 2 depletion levels compared. This soil layer had a mean root content of 86.2% for the wet, compared to 78.6% for the dry treatment. The loam under the dry treatment developed more roots with depth than the wet treatment, but not to so great an extent as was true for the loamy sand soil. Treatment effects were probably diminished in the loam soil due to a higher soil bulk density. (Baker-IVI)
W85-06205

FURROW IRRIGATION DESIGN FOR VERTISOLS,
Euroconsult, Arnhem (Netherlands).
L. K. Smedema.
Agricultural Water Management, Vol. 9, No. 3, p 211-218, November, 1984. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Furrow irrigation, *Vertisols, *Irrigation design, Soil properties, Irrigation patterns, Infiltration, Slope.

An approach is outlined for furrow irrigation on vertisols based on the simple concept of filling of a reservoir. The applicability of this concept derives from the following conditions: infiltration is a self-regulating/self-ending process. That is, once the depleted soil moisture reservoir is replenished, the infiltration effectively stops. This condition is typical not only of vertisols, but more generally of all cracking/swelling heavy land soils. The second condition is that the furrows have an even, gentle slope and are closed at the lower end. This assures a slow, retarded recession flow which enhances the uniformity of the soil moisture replenishment along the length of the furrow. On steep slopes, the recession water will tend to accumuate at the lower end of the furrow, risking overflow from the closed ends, while much of the upper reach will not have had water present for a long enough time to attain adequate soil moisture replenishment. Most vertisols have slopes that are often as little as 0.01-0.02%, and the outlined approach covers most of furrow design cases for these soils. In the design approach outlined the rate at which the head of the stream advances in the furrow is not an explicit consideration. The volume of water applied is the main factor, the distribution of this water along the furrow being assured by the self-regulating infiltrating nature of these soils. An inlet time greater than the end advance time may apply, for example, to very short furrows where the run may reach the lower end of the furrow in less time than the set minimum inlet time while an inlet time less than the end advance time may apply to very long furrows. In general, however, inlet and end advance times will be similar. (Baker-IVI)
W85-06280

WATER USE-YIELD RELATIONS FOR COWPEA AND MAIZE,
Ife Univ. (Nigeria). Dept. of Agricultural Engineering.
H. O. Fapohunda, P. O. Aina, and M. M. Hossain.
Agricultural Water Management, Vol. 9, No. 3, p 219-224, November, 1984. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Corn, *Cowpeas, *Water use, *Crop yield, Water deficit, Irrigation, Evapotranspiration, Evaporation, Nigeria.

Three cowpea varieties and one maize variety were subjected to varying irrigation treatments, ranging from water deficits to over-irrigation, on a silty loam soil classified as an Alfisol at Ile-Ife, Nigeria. There was a strong curvilinear relation between cowpea yield and evapotranspiration (R2 = 0.86 for dry matter yield and R2 = 0.87 for dry seed yield). The values of the correlation coefficient dropped to 0.62 and 0.66 for dry matter and seed yields, respectively, when a linear relation was used. When data for over-irrigated fields were omitted from the calculation, a linear relationship yielded R2 values close to unity (R2 = 0.99). Similar results were obtained on maize dry matter and grain yields in relation to evaporation. (Author's abstract)
W85-06281

TILLAGE PRACTICE EFFECTS ON WATER CONSERVATION AND THE EFFICIENCY AND MANAGEMENT OF SURFACE IRRIGATION SYSTEMS,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
D. E. Eisenhauer.
Available from the National Technical Information Service, Sprinfield, VA 22161 as PB85 157709/AS. Nebraska Water Resources Center, Lincoln, Completion Report, Sept 1984, 90 p, 9 Fig, 26 Tab, 2 Append, Project No. OWRT B-057-NEB (1), Contract/Grant No. 14-34-0001-1242.

Descriptors: *Cultivation, *Furrow irrigation, *Irrigation efficiency, Soil management, Infiltration, Runoff, Water conservation, Conservation tillage, Reduced tillage, Furrow erosion.

A 3-year field study of reduced and conventional tillage practices was conducted under furrow irrigated conditions in south central Nebraska. The field had a 0.5 percent slope and 366 m long furrows. The soil was Hastings silt loam, a deep medium textured loessial soil, and the crop was continuous corn. Advanced, recession, and infiltration was monitored during 9 irrigations. It was found that reduced tillage practices tended to increase the soil infiltration rate and the hydraulic roughness of the furrows. This change caused an increase in the time of water advance across the field and the amount of water infiltrated. This resulted in reduced irrigation efficiency and poorer distribution of water. The energy saved in field operations with reduced tillage was partially or completely offset by increased irrigation energy requirements due to the lower irrigation efficiency. Soil and nutrient losses were monitored during 4 irrigations. While soil losses were always less than 200 kg/ha per irrigation, reduced tillage did significantly reduce these losses. Rainfall runoff was determined to be about 7.6 mm lower per year for the reduced tillage systems than the conventional practices. This is an average reduction in annual runoff of about 20 percent. Study results suggest that under these soil and slope conditions, rotary till and till plans are feasible reduced tillage systems for furrow irrigation while the slot plant system is not.
W85-06315

DEVELOPMENT OF A PREDICTIVE IRRIGATION SCHEDULING INDEX USING ELECTROPHYTOGRAMS,
Arizona Univ., Tucson. Dept. of Electrical Engineering.
W. G. Gensler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157832/AS, Price codes: A02 in paper copy, A01 in microfiche. Research Project Technical Completion Report, Sept 1984. 12 p, 4 Fig, 2 Ref, Project No. USGS G828-05, Contract/Grant No. 6-828.

Descriptors: *Irrigation efficiency, *Instrumentation, Electrochemistry, Potentiometric level, Electrodes, Irrigation scheduling, plant growth, Telemetry.

The basic objective of the research is the development of an irrigation management instrument system using electrochemical and biophysical sensors placed directly on the plant in the field. The sensors were calibrated at different water regimes in furrow and drip irrigated cotton. In addition, a telemetry system was developed to transfer the signal from the field to the grower's headquarters. The system is cost effective and amenable to large scale expansion.
W85-06326

IRRIGATED AGRICULTURAL DECISION STRATEGIES FOR VARIABLE WEATHER CONDITIONS,
New Mexico Water Resources Research Inst., Las Cruces.
For primary bibliographic entry see Field 6A.
W85-06340

LEACHING AND WATER REQUIREMENT STUDIES IN A GYPSIFEROUS DESERT SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
D. Russo.
Soil Science Society of America Journal, Vol. 49, No. 2, p 432-437, March/April, 1985. 7 Fig, 3 Tab, 14 Ref.

Descriptors: *Leaching, *Desert soils, *Water requirements, *Gypsum, Soil properties, Irrigation practices, Soil water, Saline soils, Crop yield, Evapotranspiration, Chloride, Sulfates.

This study was designed to determine the interrelations of irrigation regime, soil water content, and salinity profiles and their effect on crop yield, under field conditions. The different irrigation regimes produced different soil water profiles and different leaching fractions ranging from 0.09 to 0.53 which, in turn, affected the soil salinity profiles. Analysis of the soil solution concentrations indicated that with the higher levels of leaching, the excess chloride was essentially removed out of the root zone, whereas relatively high levels of sulfate concentration were maintained as a result of gypsum dissolution which was dominated by Ca-Na exchange. Crop yields were affected by both the irrigation amount and frequency. For a given amount of water, higher yields were obtained under the more frequent (daily) irrigation. Amounts of water equal to 1.3 and 1.5 times the pan evaporation for the daily and the every 4 d irrigation, respectively, are required to maintain yields higher than 90% of the maximum. Both the evapotranspiration and crop yield were found to be highly correlated with the soil water content and salinity profiles. This indicated that the effect of both salnity stress and water stress is to reduce crop water uptake and concurrently to reduce crop production. (Baker-IVI)
W85-06540

IRRIGATION AND AGRICULTURAL DEVELOPMENT: SOME CONCEPTUAL AND EMPIRICAL CONSIDERATIONS,
Ife Univ. (Nigeria). Dept. of Agricultural Engineering.
O. Oludimu.
Journal of Environmental Management, Vol. 19, No. 2, p 175-184, September, 1984. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Nigeria, *Developing countries, *Irrigation practices, *Water conservation, Agriculture, Smallholder irrigation, River basin, Water resources development, Boreholes, Tube wells, Canals, Lakes.

Success in agricultural production efforts calls for a carefully considered administrative procedure and adequate technical apparatus to make it possible to provide inputs, services and facilities to farmers. In most developing countries, the need to provide smallholder irrigation, as a prerequisite for a successful agrarian revolution is paramount. Aspects of irrigation development in the light of Nigeria's Green Revolution program are discussed. The Itoikin Irrigation Rice Project in Nigeria provides a community example of the whole develop-

ment process. An element of basic importance in such a project is the people's cooperation. Efforts must be made to encourage the people not only to join the scheme, but also to remain and derive greater benefits and pleasure from farming. Another difficulty arises from finance. For the rapid adoption of improved agricultural practices, credit must be extended to farmers; the extension of such credit should be linked with the distribution of facilities and with produce marketing. The development of irrigation cannot be considered in isolation without consideration of other claims on water resources such as drinking and fishing. (Baker-IVI)
W85-06604

SURFACE TEMPERATURE VARIABILITY PATTERNS WITHIN IRRIGATED FIELDS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
J. L. Hatfield, M. Vauclin, S. R. Vieira, and R. Bernard.
Agricultural Water Management, Vol. 8, No. 4, p 429-437, February, 1984. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Surface temperature, *Soil water, *Irrigation effects, Infrared thermometry, Remote sensing, Irrigation scheduling, Sampling.

Variability in surface temperature within a field has been proposed as a measure for irrigation scheduling. An experiment was conducted to examine the spatial variability of surface temperature within differentially irrigated grain sorghum fields at Davis, California in 1981. Measurements were made repeatedly throughout the season in 85 m long transects measured with an infrared thermometer reading at 1.0 m intervals. Along the transects the readings at 1 m intervals were not correlated. The lack of structure or spatial dependence within a given field suggests that a random sampling in a field would be adequate for infrared thermometer measurements. During a drying cycle from one irrigation to the next, the variance of surface temperature along a transect increased. There was no statistically significant relationship between the amount of water extracted from the upper 150 cm of the profile when more than 40% of the available water remained. When more than 60% of the available water had been removed, the variance increased above 0.5 degrees C sq but below this amount the variances did not exhibit any significant pattern. The variance of surface temperature within a field may not be a sensitive indicator of the soil water status. The number of samples needed to achieve a confidence limit of 1.0 degree C about the mean was 10 samples for a field with more than 40% available soil water and increased to 20 samples as the field dried below the 60% extraction level. This technique could possibly be used to evaluate the distribution efficiency of various irrigation methods. (Moore-IVI)
W85-06688

EVAPORATION AND DRIFT LOSSES FROM SPRINKLER IRRIGATION SYSTEMS UNDER VARIOUS OPERATING CONDITIONS,
Cukurova Univ., Adana (Turkey). Coll. of Agricultural Engineering.
A. Yazar.
Agricultural Water Management, Vol. 8, No. 4, p 439-449, February, 1984. 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Evaporation, *Drift, *Sprinkler irrigation, Wind, Vapor pressure deficit, Irrigation efficiency, Irrigation practices.

Quantitative determinations of evaporation and drift losses from sprinkler systems were carried out under different operating conditions. Evaporation losses determined by an electrical-conductivity method ranged from 1.5 to 16.8% of the total sprinkled volume. Wind velocity and vapor pressure deficit were the most significant factors affecting the evaporation losses. Exponential relationships between the evaporation losses and both wind velocity and vapor pressure deficit have been found. For the operating pressures used in this study the least effect on evaporation was found. Drift losses measured by the magnesium-oxide method varied from 1.5 to 15.1%. Drift losses increased with the second power of the wind velocity, and decreased with increasing distance in the downwind direction. Combined losses from a sprinkler system for a given set of operating conditions have been estimated by using the results obtained from the experiments. Combined losses ranged from 1.7 to 30.7% of the applied water. (Author's abstract)
W85-06689

HISTORY OF DESALTING WATER IN THE VIRGIN ISLANDS,
CH2M Hill International Corp., Gainesville, FL.
O. K. Buros.
Desalination, Vol. 50, p. 87-101, October-November, 1984. 4 Tab, 11 Ref.

Descriptors: *Desalination, *Virgin Islands, *Water supply development, Seawater, Water demand, Water resources development, Potable water, Solar distillation.

The history and economy of the US Virgin Islands have been intimately connected to its water resources. The historically recognized need and high cost of potable water in the Virgin Islands have stimulated people to propose and experiment with a variety of innovative water resource concepts in the Territory. The Virgin Islands has used dual water systems, rainwater harvesting, dams and reservoirs, wastewater reclamation, artificial recharge of groundwater and desalination to name a few. The development of desalination technology occurred almost simultaneously with the rapid growth of the population in the Islands. One of the earliest experiments took place in 1948-49. A solar humidification process was used to produce potable water from seawater. The real move to desalination started in 1958 when Congress authorized the Territory to construct, operate, and maintain saltwater distillation facilities in St. Thomas. The plant was completed in 1962. Two industrial complexes located on St. Croix were early users of distillation plants. The plants helped supply fresh water for the refineries that was independent of the government's supply. Over the years about 50 plants have been installed in the Territory. Aside from serving as a location for sales of desalination equipment, the Territory has also aided in furthering desalination technology through education and research. (Baker-IVI)
W85-06692

CHANGES IN SOUTHERN CHERNOZEMS AFTER DRIP IRRIGATION,
Leningrad State Univ. (USSR).
I. N. Panasenko, V. B. Petrov, and E. I. Gagarina.
Soviet Soil Science, Vol. 16, No. 5, p 99-108, September/October, 1984. 2 Fig, 4 Tab, 19 Ref. Translated from Pochvovedeniye, No. 4, p 61-70, 1984.

Descriptors: *Drip irrigation, *Chernozems, *Crimea, *Salts, Chemical composition, Salinization, Soil properties, Irrigation practices.

Changes in the properties of Southern Chernozems in the steppe region of the Crimea after 4 years of drip irrigation with weakly mineralized water were studied. In contrast to sprinkling, there was no compaction of the soil or destruction of its structure in the moistening contour, but there was a seasonal accumulation of toxic salts, both brought in with their irrigation water and attracted from the lower horizons. In spite of the unquestionable advantages of drip irrigation, this tendency for salts to accumulate in the soaked area, which coincides with the main zone of root development, and some dispersion of the soil particles in the middle of the profile indicate the need for soil scientists and agrochemists to make station observations on the seasonal state of the soil when this method of irrigation is used. (Baker-IVI)
W85-06750

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

PRACTICAL IMPLICATIONS IN THE USE OF STOCHASTIC DYNAMIC PROGRAMMING FOR RESERVOIR OPERATION,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter, and F.-K. Tai.
Water Resources Bulletin, Vol. 21, No. 1, p 65-74, February, 1985. 6 Fig, 3 Tab, 17 Ref.

Descriptors: *Reservoir operation, *Dynamic programming, Hydroelectric plants, Computers, Stochastic process, Probability, Water storage.

A stochastic dynamic programming model is applied to a small hydroelectric system. The variation in number of stage iterations and the computer time required to reach steady state conditions with changes in the number of storage states is investigated. The increase in computer time required to develop the storage probability distributions with increase in the number of storage states is reviewed. It is found that for an average of seven inflow states, the largest number of storage states for which it is computationally feasible to develop the storage probability distributions is nine. It is shown that use of the dynamic program results based on a small number of storage states results in unrealistically skewed storage probability distributions. These skewed distributions are attributed to 'trapping' states at the low end of the storage range. (Author's abstract)
W85-06240

STUDY OF RESIDENTIAL STORMWATER IMPOUNDMENTS: PERCEPTIONS AND POLICY IMPLICATIONS,
Petroglyph Research Associates, Chilliwack (British Columbia).
E. H. Baxter, G. Mulamoottil, and D. Gregor.
Water Resources Bulletin, Vol. 21, No. 1, p 83-88, February, 1985. 4 Tab, 4 Ref. Environment Canada, Inland Waters Directorate contract OSE80-00124.

Descriptors: *Storm runoff, *Detention reservoirs, *Public policy, *Housing, recreation, Public opinion, Stormwater, Maintenance, Mississauga, Ontario.

The traditional solution to stormwater runoff from housing developments has been stormwater sewer systems. A newer and increasingly popular solution is some sort of impoundment or 'lake' within the development, which is thought to be cheaper, to provide recreation, to improve the aesthetics of the environment, and to increase property values. Little is known of the acceptability of these to public officials, developers, or potential residents, or of their policy implications. Two such developments in Mississauga, Ontario, were studied, in terms of the perceptions and opinions of a random sample of residents and of officials who had been involved in their planning and management. The areas have attracted a relatively young group, just beginning their child-bearing years, with relatively high income and education. The lakes appear to be popular, and relatively successful, especially the one which provides more recreational opportunities, and which has had fewer maintenance problems. The major problems are visual and safety. The City, and to some extent the developers, are seen as the appropriate groups to manage and maintain the lakes. Some suggestions, based on residents' and officials' responses, are presented for future designs and policy formulation. (Author's abstract)
W85-06242

DEVELOPMENT OF A COMPREHENSIVE UPPER COLORADO RIVER BASIN MODEL

FOR ANALYZING ENERGY DEVELOPMENT IMPACTS,
Utah Water Research Lab., Logan.
A. B. Bishop, R. Narayanan, M. McKee, and M. T. Nussbaum.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157808/AS, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, Sept. 1984. 116 p, 19 Tab, 6 Fig, 5 Append, Project No. USGS G872-03.

Descriptors: *Utah, *Water management, *Model studies, River basin development, Management planning, *Water allocation, Resources development, Planning.

Recent advances in detection technologies, data management and retrieval systems, and modeling capabilities have led to a large number of conceptual and applied models that are already making significant contributions to water resources management in the Colorado River Basin. The potentially useful modeling concepts and applications are inventoried from agency contacts and the literature and are assessed for usefulness in the context of the physical, hydrologic, water use, flood damage potential, recreation use, environmental, economic, social, and cultural characteristics of the Basin. Modeling potentials are also assessed in the context of the history of water resources development and management in the basin and the water laws and institutions that have evolved for their administration. Thus, model applications are reviewed in terms of both physical needs and institutional acceptability for water management decisions that affect water allocations within and among states and with Indian tribes. The literature describing scientific and engineering studies and the model development for applications in the Colorado Basin display parallels between time trends in the values and resulting policy on water resources development prevailing in the Basin and the research conducted. These relationships are then assessed and extrapolated, subject to the constraints on modeling capability documented in the literature, to project future modeling directions. The study ends with the conceptualization of an integrated modeling approach for Basin water management.
W85-06323

STORMWATER MANAGEMENT ALTERNATIVES - A COMPUTER-BASED PROGRAM FOR THE SELECTION OF TECHNIQUES TO MITIGATE THE IMPACT OF URBAN STORMWATER,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W85-06328

INVENTORY OF COURT CREEK WATERSHED CHARACTERISTICS THAT MAY RELATE TO WATER QUALITY IN THE WATERSHED,
Illinois State Water Survey Div., Peoria. Water Quality Section.
For primary bibliographic entry see Field 2A.
W85-06331

MANAGING RIVER SYSTEMS: CENTRALIZATION VERSUS DECENTALIZATION,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
P. R. Wandschneider.
Natural Resources Journal, Vol. 24, No. 4, p 1043-1066, October, 1984. 1 Fig, 148 Ref.

Descriptors: *Rivers, *Water management, *Centralization, *Decentralization, Political aspects, Economic aspects, Decision making, Planning, Columbia River.

Some positive and normative qualitites of the decentralized-negotiated approach to river management are explored. The question of whether decentralized management of such an interdependent physical system is possible was addressed. By theory and the example of the Columbia River management structure a decentralized management approach was proved viable. In the Columbia River case, however, solving problems of interdependence often required some application of such centralizing approaches as merging of firms, public provision, or government regulation. The consequences of employing a decentralized-negotiated management approach for questions of externalities and conflict resolution were also considered. Evidence presented in this case study suggests that no general recommendations for decentralized or centralized river basin management structure are justified. The choice of institutional forms cannot be reduced to a few relatively simple rules. After very careful study of the potential consequences the choice must be made. The economist contributes to the understanding of potential consequences. The ultimate choice is ethical and political. (Baker-IV)
W85-06536

STUDY AND PLANNING OF RESERVOIR DESILTING IN TAIWAN,
Taiwan Provincial Water Conservancy Bureau, Taichung City.
J. Hwang.
Water International, Vol. 10, No. 1, p 7-13, March, 1985. 7 Fig, 2 Tab, 10 Ref.

Descriptors: *Reservoirs, *Desilting, *Taiwan, Sediment transport, Flushing, Erosion control, Sedimentation, Reservoir operation.

The reservoir sedimentation rate in southern Taiwan is very high. Without any special scheme to deal with the sediment, a reservoir in this area will be silted in a short time and the project will be unfeasible economically. The special water utilization pattern and reservoir sediment control scheme which are conceived for the southern regin of Taiwan and the Ho-Ku Reservoir are first to use the available run-of-the-river water, then arrange an empty period for the Ho-Ku Reservoir to sluice the turbid water during the flood seasons and store clean water. This is mostly diverted from the upstream reaches of the Kaopin River at the end of the flood season for the supplementary uses of the region, from October through the following May. According to the flow routing, trap efficiency computation and flushing efficiency estimation, the forebay of Ho-Ku Reservoir will function as a settling basin and will contain almost no permanent deposition. The probable life of the afterbay of Ho-Ku Reservoir would be prolonged from 70 years without any silting scheme to 470 years with the special operating pattern. Although the Ho-Ku Reservoir is still being planned it has been decided to develop it according to the desilting scheme and water utilization pattern starting in 1986. In order to assure the flushing efficiency of the Ho-Ku Reservoir, it was suggested that a hydraulic model experiment be carried out to compare the results of the test with the mathematical computations. (Baker-IVI)
W85-06542

IMPACT OF ALTERNATIVE HOUSING STANDARDS ON STORMWATER MANAGEMENT,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, H. Ellis, and G. Mulamoottil.
Canadian Journal of Civil Engineering, Vol. 12, No. 1, p 192-199, March, 1985. 5 Fig, 3 Tab, 6 Ref.

Descriptors: *Drainage, *Storm runoff, *Urban hydrology, *Housing, *Ontario, *Urban runoff, Storm water, Water management, Overland flow, Drainage systems, Design criteria, Costs.

The Ontario Ministry of Housing suggested new standards for urban development for residential subdivisions. The proposed design standards include: roof discharges to the ground surface; road drainage through catch basins, with spacings adjusted to reflect gutter and inlet capacities; storm sewers only as needed; and the pipe system designed to carry a 2 year storm with the remainder of the runoff transmitted overland. The per lot proposed system costs were approximately 50-70% of those associated with the conventional design. The savings per lot associated with the proposed system are essentially all attributable to the distribution of the pipe costs along the streets over a larger number of households. The proposed system-related costs represent a per lot savings in stormwater management costs from $400 to $900, depending on the alternative conventional design practices that would otherwise be adopted. The proposed system will also have an increased nuisance arising from more frequent street flooding but, if designed correctly, these should not represent dollars of flood damage. There is a reduction in the aesthetics associated with the proposed system because of the reduced lot sizes. There is also a deterioration in the water quality runoff associated with the proposed system. (Baker-IVI)
W85-06554

PERSISTENCE AND FATE OF 2,4-D BUTOXYETHANOL ESTER IN ARTIFICIAL PONDS,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5B.
W85-06621

COMPLICATED BELGIAN SEWERAGE SYSTEM,
Liege Univ. (Belgium).
V. De Kosinsky.
European Water and Sewage, Vol. 89, No. 1067, p 8-12, January, 1985. 5 Fig.

Descriptors: *Sewer systems, *Belgium, *Liege, *Flood control, Storm runoff, Rivers, Flooding, Mining, Subsidence, Urban areas, Drainage.

A very typical example of a combined set of sewerage problems low lying urban areas can meet exists in and around Leige, one of the largest towns in Belgium. The origins of the problems are fourfold: heavy mining subsidences resulting in more and more areas settling below the level of the river; very high flood discharges in the river Meuse crossing the region; river regulating works artificially upholding the level of the river for investigation purposes; and flood-walls protecting low lying areas also impeding the flow of storm water into the river. The municipalities of the valley created a cooperative association charged with the design, construction and operation of a special sewerage system, called the Demergement. In the areas upstream of the city, most of the works are finished and there has been no inundation since 1926, the sewerage functioning perfectly even during flood conditions. Even the cellars are dry except in a few streets. In the downstream municipalities, which joined the Association only after the Second World War, there is still much to do, and not all areas are yet safe from the flooding of the river or from heavy storms. The Association has 56 years of specialized experience in urban sewerage and its works and management have been most successful in keeping the region free from flooding. In the first 50 years the actual investment amounted to 120 million US dollars, and the Demergement system discharges into the river an average of 29 cubic Mm/a of water. (Baker-IVI)
W85-06811

NEW CANAL AND IMPROVEMENTS AVERT STORMWATER RUNOFF PROBLEMS,
Stottler, Stagg and Associates, Inc., Cape Canaveral, FL.
M. E. McLouth.
Public Works, Vol. 116, No. 5, p 76-77, 106, May, 1985. 2 Fig.

Descriptors: *Canals, *Storm runoff, *Flood control, *Florida, *West Palm Beach, Planning, Water management, Detention reservoirs, Pumping.

A potential flooding problem exists in the West Palm Beach area of Florida. A plan determined that the potential flooding problem was correctable through improving existing minor canals in the project area and constucting a major 2.8 mile canal extending west to a proposed 721 acre earth detention area near the L-8 Canal. The design includes two pump stations, which allow water to be pumped north and away from the West Palm Beach Canal and west to the earth detention area.

Duuring peak wet periods, water in the detention area will be released at a controlled rate through two 54-in. corrugated metal pipe culverts, discharging into an outfall canal directed to the L-8 Canal. The allowable discharge permitted by the plan will be controlled by 21 ft high flood gates. During dry periods high water in the detention area can be used to raise the water table adjacent to the canal system wthin the M-1 acreage through the manual operation of the back flow control structures at the two pump station and at the canal plug at the Royal Palm Beach interface. (Baker-IVI)
W85-06836

NITROGEN AND ESTABLISHMENT OF A BEETLE FOR BIOLOGICAL CONTROL OF THE FLOATING WEED SALVINIA IN PAPUA NEW GUINEA,
Commonwealth Scientific and Industrial Research Organization, Indooroopilly (Australia). Long Pocket Labs.
P. M. Room, and P. A. Thomas.
Journal of Applied Ecology, Vol. 22, No. 1, p 139-156, April, 1985. 7 Fig, 2 Tab, 37 Ref.

Descriptors: *Aquatic weed control, *Beetles, *Salvinia, *Biological control, *Papua, *New Guinea, Weed control, Aquatic plants, Ferns, Insects, Nitrogen, Phosphorus, Plant growth.

A population of 570 adult Cyrtobagous sp. (Coleoptera: Curculionidae) released into two field cages containing the host fern Salvinia molesta Mitchell declined to about forty adults over nearly 7 months or about four generations. Eleven weeks after adding another 592 adults to the cages, and starting weekly application of urea fertilizer, there were approximately 3000 adults present. A field enclosure experiment in which insects were placed on unsprayed control plants, on plants sprayed with N fertilizer and on plants sprayed with N + P fertilizer produced additional evidence that the rate of insect population increase could be manipulated by application of N to the host plant. On release from cages, and in the unsprayed control treatment, populations of the insect increased exponentially despite there being very low concentrations of N in the host plant. By damaging its host, the insect can increase the quality of the host as food; there might be a 'critical' population density of the insect for particular population densities and low N-contents of the host, below which a population of the insect will decline and above which it will increase. Slow dispersal by the insect, despite its ability to fly, at several sites may be the result of selection in favor of populations remaining above 'critical' densities. The dispersal behavior contrasts markedly with that of insects suspected of responding to induced defenses in their host plants. Some practical implications of the results for biological control of weeds and management of crop pests are discussed. (Author's abstract)
W85-06891

INVENTORY AND ASSESSMENT OF AQUATIC PLANT MANAGEMENT METHODOLOGIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
E. A. Dardeau, and E. A. Hogg.
Final Report, Jan. 1983. 86 p, 3 Fig, 4 Tab, 91 Ref, 2 Append.

Descriptors: *Weed control, *Aquatic weed control, Aquatic plants, Monitoring, Surveys, Public opinion, Remote sensing, Species composition, Biomass, Herbicides, Mechanical control, Physical control, Biocontrol, Fish, Insects, Water hyacinth, Hydrilla, Alligatorweed, Pathogens, Water level fluctuation, Screens, Training, Waterways.

Available methods for aquatic weed control are reported and assessed. Information was gathered from a literature survey and a telephone survey of 14 Corps of Engineers Districts with active aquatic weed management programs. More data was obtained for treatment and monitoring than for the other subjects in the survey: reporting, public awareness, and training. Treatment programs discussed include chemical, mechanical (hand removal, barrier systems, harvesting), biological (insects, fish, pathogens, etc.), environmental (water level fluctuation, bottom screens, chemical light shades), and integrated treatments. Monitoring methods are divided into ground surveys and remote sensing surveys. Appendix A lists problem aquatic plant species. Appendix B details the telephone survey results.
W85-06898

FIELD EVALUATION OF TWO ENDOTHALL FORMULATIONS FOR MANAGING HYDRILLA IN GATUN LAKE, PANAMA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. E. Westerdahl.
Technical Report A-83-3, January 1983. Final Report. 171 p, 40 Fig, 9 Tab, 36 Ref, 5 Append.

Descriptors: *Herbicides, *Lakes, *Aquatic weed control, *Pesticide kinetics, *Pesticides, Performance evaluation, *Water pollution effects, *Pesticide residues, Aquatic weeds, Plankton, Ecological effects, Endothall, Water pollution prevention, Water quality management.

Two endothall formulations (Aquathol K and Hydout) were evaluated for their ability to control hydrilla on the Frijoles Bay area of Gatun Lake, Panama. Each formulation was applied to endothall acid equivalent rates of 27, 34, and 50 kg/ha. Aquathol K provided control of hydrilla within 24 to 72 hr posttreatment at each application rate; however, Hydout required 14 to 21 days before hydrilla control was evident at the two higher application rates. No adverse impacts were observed on selected water quality parameters after endothall treatment and only transitory shifts in the plankton community composition and vertical distribution over the 49-day study period took place. Endothall was detected in the water from the buffer zones of those plots treated with Aquathol K. Negligible endothall residues were found in the buffer zones surrounding the plots treated with Hydout throughout the 90-day post-treatment study period. Combination of Aquathol K and Hydout are recommended as a suitable alternate to copper sulfate to managing hydrilla on Gatun Lake.
W85-06900

PROCEEDINGS, 17TH ANNUAL MEETING, AQUATIC PLANT CONTROL RESEARCH PROGRAM, NOVEMBER 16-18, 1982, SACRAMENTO, CA.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
June 1983. Final Report. 169 p. Miscellaneous Paper A-83-83.

Descriptors: *Weed control, *Aquatic plants, *Herbicides, Boating, Waterways, Hydrilla, Water hyacinth, Biocontrol, Watermilfoil, 2,4-D, Fish, Grass carp, White amur, Microbiology, Insects, Fungi.

The 17th annual meeting of the Corps of Engineers Aquatic Plant Control Research Program covered the following topics: the role of boating and waterways in aquatic plant management in California's Delta; aquatic plant problems in geographical divisions of the U.S.; management of aquatic weeds by biological control, chemical control, mechanical control, 2,4-D, and white amur; research on grass carp and other herbivorous fish; biological control with microorganisms, the pyralid moth, insects, and fungi; natural hydrilla growth inhibitors; fiber formulas for controlled release of herbicides; controlled release of herbicides, effects of organic matter additions to sediment on the growth of hydrilla; and evaluating the effectiveness of aquatic plant treatment methods.
W85-06901

AQUATIC BIOTA OF BANK STABILIZATION STRUCTURE ON THE MISSOURI RIVER, NORTH DAKOTA,
National Fishery Research Lab., La Crosse, WI.
For primary bibliographic entry see Field 6G.
W85-06902

KAHOMA STREAM CHANNEL IMPROVEMENT PROJECT, MAUI, HAWAII: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. F. George.
Technical Report HL-82-19, August 1982. Final Report. 104 p, 3 Fig, 8 Tab, 30 Photos, 44 Plates.

Descriptors: *Hydraulics, *Hydraulic structures, *Channel improvement, *Flood control, Hydraulic models, Streams, Kahoma Stream, Hawaii, Model studies, Weirs, Channel morphology, Scour, Sedimentation, Erosion control, Flow control, Roughness coefficient.

A 1:30-scale model of Kahoma Stream, on Maui, Hawii, was used to determine the adequacy of proposed channel improvements consisting of a debris basin with a concrete weir (storage capacity, 55,000 cu yd), a concrete-lined trapezoidal channel from the debris basin to the ocean, and new bridges to accomodate the design flood. Wherever unsatisfactory flow conditions were observed, modifications were made to the original design so that satisfactory conditions were obtained. The weir was modified to a three-sided formation with a wedge-type transition. The wedge-shaped design of the bridge transition was changed to a warped-surface design. Slopes of the high-velocity channel were adjusted to produce a Manning's n coefficient of 0.015 rather than 0.013 in the prototype. Additional roughness placed in a downstream portion of the channel for aesthetic purposes increased water surface elevations, requiring raising the elevation of some channel walls. When a large scour hole developed offshore, the trapezoidal channel was extended and boulder concrete section was added to minimize scour and deposition.
W85-06904

PERFORMANCE OF PLASTIC CANAL LININGS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8C.
W85-06910

DETERMINATION OF CHEMICAL THRESHOLD CONCENTRATIONS USING 2,4-D TO CONTROL SELECTED AQUATIC MACROPHYTES: A PILOT STUDY TO EVALUATE A LABORATORY SYSTEM,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. E. Westerdahl, R. E. Hoeppel, E. Hummert, and L. Williams.
Technical Report A-83-4, February 1983. Final Report. 37 p, 14 Fig, 4 Tab, 17 Ref.

Descriptors: *Weed control, *Aquatic weed control, *Herbicides, Aquatic plants, 2,4-D, Macrophytes, Watermilfoil, Pondweed, Diluter system.

The objectives of this pilot study focused on the evaluation of a modified diluter system used to determine the minimum sustained (threshold) herbicide concentrations required to control nuisance aquatic macrophytes. The herbicide 2,4-dichlorophenoxy acetic acid (2,4-D) was used during this pilot study to provide data for evaluating the diluter system operation as well as to provide initial estimates of the threshold 2,4-D concentration required to control Eurasian watermilfoil (Myriophyllum spicatum L.) and Sago pondweed (Potamogeton pectinatus L.). The experimental design included three replicate aquaria containing each of the aforementioned plant species planted in beakers containing a standard hydrosoil, and one reference aquarium without plants exposed for 6 weeks to each of several 2,4-D concentrations: 0.00, 0.01, 0.04, 0.10 and 0.20 mg per liter. Results of this pilot study showed that the modified diluter system was completely satisfactory for this work. Moreover, estimates of the threshold 2,4-D concentrations needed to control the aforementioned plants were: 0.1 mg per liter for M. spicatum, and 0.2 mg per liter for P. pectinatus. These results will be verified following completion of recommended changes in the diluter system. (Author)

W85-06917

SIMULATION FOR HARVESTING OF AQUATIC PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
E. R. Perrier, and A. C. Gibson.
Technical Report A-82-1, February 1982. Final Report. 54 p, 10 Fig, 4 Tab, 4 Ref, 1 Append.

Descriptors: *Weed control, *Aquatic weed control, *Computer programs, Model studies, Aquatic plants, Mechanical control, SHAP model, Mathematical models, Linear programming, Simulation analysis, Waterways, St. Johns River, Orange Lake, Florida.

The computer program, 'Simulation for Harvesting of Aquatic Plants (SHAP),' helps in planning for mechanical harvesting of plant-infested areas. The user-interactive model provides a stochastic simulation that evaluates the harvesting system. It uses linear programming theory for network flow analysis and queuing theory. The terrain subroutine organizes irregularly shaped plant-infested areas to be harvested into a distance-flow network. The harvesting subroutine directs the harvesting procedure. After harvesting by mowing, the plants are loaded by the transporter onto a conveyor and into a dump truck for disposal. After the harvesting process has been completed, the statistics of time and queuing operations for each component are computed. The model was verified with data from locations in Florida: Orange Lake East and Orange Lake West (hydrilla) and St. Johns River (hyacinth).
W85-06922

MICROBIOLOGICAL CONTROL OF EURASIAN WATERMILFOIL,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
H. B. Gunner.
Miscellaneous Paper A-83-4, June 1983. Final Report. U.S. Army Aquatic Plant Control Research Program, Army Engineer Waterways Experiment Station, Vicksburg, MS. 25 p, 6 Fig, 10 Tab, 25 Ref. Contract/Grant No. DACW39-80-C-0029.

Descriptors: *Watermilfoil, *Aquatic weeds, *Aquatic weed control, *Microorganisms, *Enzymes, *Microbiological studies, *Biocontrol, *Plant pathology, Cellulose, Pathogens, Bacteria, Pathogenic bacteria, Rhizosphere.

Cellulolytic and pectinolytic microorganisms were isolated from the natural microbial populations occurring on the phyllosphere of Eurasian watermilfoil, Myriophyllum spicatum and M. heterophyllum. The yield of their respective operative enzymes was maximized by growth in appropriate cellulose and pectin media. When applied to watermilfoil, these isolates accelerated plant necrosis and decline. A consortium of cyanobacteria associated with Myriophyllum was also found to accelerate necrosis. In keeping with ecosystem specificity, there should be a much higher pathogenic potential of the isolates from M. spicatum to that species than to M. heterophyllum. These results suggest that microorganisms native to the Myriophyllum ecosystem and amendments applied to the environment stimulating the growth of such populations, offer promise as biological control agents for the management of aquatic weeds.
W85-06938

BIG CREEK FLOOD-CONTROL PROJECT CLEVELAND, OHIO: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W85-06994

COMPATIBILITY AND INFECTIVITY OF A CERCOSPORA RODMANII FORMULATON WITH ENHANCING AGENTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. C. Pennington, and E. A. Theriot.
Miscellaneous Paper A-83-6, June 1983. Final Report. 23 p, 2 Fig, 5 Tab, 14 Ref.

Descriptors: *Aquatic weeds, *Aquatic weed control, *Biocontrol, *Water hyacinth, *Aquatic fungi, *Fungi, *Germination, *Plant diseases, Aquatic plants, Biocides, Plant pathology, Plant growth.

A formulation of the fungus Cercospora rodmanii Conway was produced and tested as a biocontrol agent for waterhyacinth (Eichhornia crassipes (Mart.) Solms.). Twelve germination enhancers were tested on two lots of the fungus formulation in laboratory experiments. C. rodmanii formulation was sprayed with compatible test agents on waterhyacinth pseudolaminae and damage was monitored each week for 8 weeks by assigning a disease index to each original and new pseudolaminae. Results showed that no spots characteristic of C. rodmanii infection were detected at any time during the study period. Microscopic and cultural examinations of pseudolaminae yielded no evidence of infection by the C. rodmanii formulation. Analysis of variance of mean disease indices showed no significant differences between treatments and controls. Since C. rodmanii formulation was not infective, the effects of test agents on infectivity could not be determined. It was suggested that a virulent strain of C. rodmanii be isolated from the field. Germination enhancers determined to be compatible with fungus in this study could then be reexamined for the ability to enhance the infectivity of such a C. rodmanii formulation.
W85-06997

SIMULATED MECHANICAL CONTROL OF AQUATIC PLANTS IN BUFFALO LAKE, WISCONSIN,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
B. M. Sabol.
Miscellaneous Paper A-83-8, October 1983. Final Report. 49 p, 9 Fig, 14 Tab, 15 Ref.

Descriptors: *Aquatic plants, *Computer models, *Model studies, *Aerial photography, *Aquatic weed control, *Simulation analysis, *Plant populations, *Plant growth, Aquatic productivity, Aquatic weeds, Population density, Cost analysis, Lakes, Coontail, Primary productivity, Models.

To determine the operational time required to mechanically control nuisance-level growth of aquatic plants in Buffalo Lake, Wisconsin, a computer model (HARVEST) was used which simulates all important steps in a mechanical control operation. Model inputs include plant density, distance to nearest disposal site, and mechanical and performance specifications for the harvesting system used. Plant densities were determined at two different times during the growing season by conducting a quantitative field sampling program coupled with aerial photography. A treatment area was selected which consisted of boat lanes covering approximately 20% of the area in the eastern two thirds of the lake. The Aquamarine H8-650 and H-400 harvester were selected for simulation. Mechanical control operations were simulated in the treatment area for the two summer periods using each harvester working alone and with a single Aquamarine T-650 transport unit. Surface-topped growth of aquatic plants within the harvestable portion of Buffalo Lake during early and late summer periods covered 35 and 50%, respectively, of that area. Harvestable density within the treatment area during early and late summer periods averaged 5.9 and 7.9 tons/acre, respectively. Coontail was the dominant plant species encountered. Predicted control operation times ranged from 215 to 440 hr for the early summer period and 297 to 627 hr for the late summer period. Predicted production rates were greatest for the H8-650 harvester working with a transport unit. (Author's abstract)
W85-06998

4B. Groundwater Management

IRRIGATION AND GROUNDWATER DEPLETION IN CADDO COUNTY, OKLAHOMA,
North Texas State Univ., Denton. Dept. of Geography.
J. M. Harlin, and C. Wijeyawickrema.
Water Resources Bulletin, Vol. 21, No. 1, p 15-22, February, 1985. 9 Fig, 22 Ref.

Descriptors: *Groundwater recession, *Irrigation demand, *Caddo County, *Oklahoma, Groundwater irrigation, Water use, Peanuts, Crop production, Groundwater management.

Approximately 1/2, or about 950 sq mi, of the area covered by the Rush Springs Sandstone aquifer is in Caddo County, Oklahoma. The quality of the groundwater within the aquifer is generally good for agricultural and domestic purposes. Groundwater irrigation is highly developed over portions of the aquifer, especially in Caddo County, north of the Washita River. Ninety-six percent of the groundwater resources used in Caddo County are used for irrigation. A rapid decline in the water table has been detected in Caddo County. Fifty-six persent of total groundwater withdrawn during the period 1975-1979 in Caddo County was for the irrigation of peanuts. Declining groundwater levels may seriously threaten agricultural production in Caddo County for the present generation of farmers even if groundwater use continues at present levels. Careful irrigation management and perhaps more research on optimal irrigation techniques would prolong the availability of groundwater. (Moore-IVI)
W85-06234

FRACTURE TRACE ANALYSIS TO INCREASE THE PROBABILITY OF LOCATING GROUNDWATER FOR MURRAY COUNTY, GEORGIA,
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
For primary bibliographic entry see Field 2F.
W85-06313

FY 83 PROGRAM SUMMARY REPORT OF UTAH CENTER FOR WATER RESOURCES RESEARCH,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 9D.
W85-06322

GROUNDWATER MANAGEMENT PLAN FOR STUDY AREA 1, COASTAL PLAIN FORMATIONS,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 6F.
W85-06334

SPECIAL GROUND WATER STUDY, BASIN-WIDE REPORT AND EXECUTIVE SUMMARY.
Delaware River Basin Commission, West Trenton, NJ.
For primary bibliographic entry see Field 2A.
W85-06337

SPECIAL GROUNDWATER STUDY OF THE UPPER DELAWARE RIVER BASIN, STUDY AREA III, VOLUME II.
Wright (R.E.) Associates, Middletown, PA.
For primary bibliographic entry see Field 6E.
W85-06338

MULTI-OBJECTIVE OPTIMIZATION MODEL FOR AQUIFER MANAGEMENT UNDER TRANSIENT AND STEADY-STATE CONDITIONS,
Nebraska Univ., Lincoln. Dept. of Mathematics.
J. P. Dauer, J. F. Hullett, and Y.-H. Liu.
Applied Mathematical Modelling, Vol. 9, No. 1, p 21-26, 1985. 5 Fig, 4 Tab, 6 Ref.

Descriptors: *Waste disposal, *Model studies, *Aquifer management, Groundwater management, Aquifers, Groundwater, Mathematical models.

In aquifer management one may wish to achieve a high discharge rate without lowering groundwater heads. Since these two objectives are not commensurable, the trade-offs between the objectives need to be analyzed to understand the interaction between them. A multiple objective waste-disposal model is developed and analyzed. The model is a modification of the single objective waste-disposal model of Alley, Aguado and Remson. The model has three non-commensurable objectives. The solution obtained by Alley is compared with the optimal solution, which is obtained via the multiperiod model. The numerical values of the objectives obtained by the two methods are very close. The solution structures vary substantially between the two methods. This demonstrates that the multiperiod nature of the waste-disposal field is more fully realized via the multiperiod model. A multiobjective analysis of the multi-period model is performed. This approach produces the trade-off values betwen objectives. These values are used in order to analyze the interaction between the objectives. The results demonstrate the comprehensive analysis of the objectives and their interaction which is possible using this model. (Baker-IVI)
W85-06562

EVAPOTRANSPIRATION OF FOUR MAJOR AGRICULTURAL PLANT COMMUNITIES IN THE SOUTH-WEST OF WESTERN AUSTRALIA MEASURED WITH LARGE VENTILATED CHAMBERS,
Western Australia Dept. of Agriculture, South Perth. Div. of Resource Management.
For primary bibliographic entry see Field 2D.
W85-06675

LUMPED PARAMETER MODEL: FURTHER APPLICATION IN CHALK AQUIFERS, U.K.,
Binnie and Partners, London (England).
For primary bibliographic entry see Field 2F.
W85-06827

LOWERING THE WATER TABLE WITH RADIAL DRAINS,
L. K. Ginzburg, and V. B. Shvets.
Soil Mechanics and Foundation Engineering, Vol. 21, No. 5, p 200-203, September/October, 1984. 3 Fig, 5 Ref. Translated from Osnovaniya, Fundamenty i Mekhanika Gruntov, No. 5, p 12-14, September/October, 1984.

Descriptors: *Water table, *Radial drains, Drainage, Construction, Costs, Drilling, Pumps.

A rise in the water table is frequently observed at construction sites. Because of the difficulty in the use of vertical and horizontal drains at construction sites, radial drains have recently come into use. Radial drains are drains that run horizontally off vertical main shaft drains. By drilling the vertical shafts deep enough, the horizontals go under basements and utilities. An example is given of the analysis, construction and operation of a system of radial drains at a factory. Specialized construction organizations should be called upon to perfect the method of radial drainage; they can assist in working out standard technological flow charts for dewatering with radial drains. The operating expenses incurred for radial drainage are negligible since they consist primarily in the monitoring the automatic operation of the pumps, repair of pumps, and outlays for electricity. (Cutty-IVI)
W85-06841

PILOT-SCALE INVESTIGATION OF PARTICLE RETENTION DURING ARTIFICIAL RECHARGE,
Asian Inst. of Tech., Bangkok (Thailand).
S. Vigneswaren, S. Jeyaseelan, and A. Das Gupta.
Water, Air and Soil Pollution, Vol. 25, No. 1, p 1-13, 1985. 9 Fig, 5 Ref.

Descriptors: *Artificial recharge, *Pilot plants, *Particle retention, Water supply development, Mathematical models, Model studies, Sand, Groundwater recharge.

One of the major limitations of artificial recharge is the clogging of pores by suspended solids present in recharging water. An experimental investigation was conducted using a pilot-scale artificial recharge model to study the temporal and spatial variation of particle retention in the sand pores. The experimental results were compared to a mathematical model characterizing physical clogging in artificial recharge. The particle retention within the aquifer during artificial recharge is physico-chemical in nature. Therefore a laboratory or pilot-scale experimental study, with the same media and recharging water which are used in real conditions, is essential to evaluate the parameters characterisic to the aquifer and recharging water. It was evident from this study that the proposed mathematical model along with a limited number of deep bed filter experiments can be successfully used to predict the particle retention profile during artificial recharge. (Baker-IVI)
W85-06886

4C. Effects On Water Of Man's Non-Water Activities

PORT SOLVES ENVIRONMENTAL PROBLEMS,
Port of Long Beach, CA.
For primary bibliographic entry see Field 5C.
W85-06176

EFFECTS OF FORESTRY ON WATER QUALITY AND FISH IN WELSH RIVERS AND LAKES,
Welsh Water Authority, Powys (Wales).
For primary bibliographic entry see Field 5C.
W85-06574

MODIFICATION OF BOG VEGETATION BY POWER UTILITY RIGHTS-OF-WAY,
Tufts Univ., Medford, MA. Dept. of Biology.
N. H. Nickerson, and F. R. Thibodeau.
Journal of Environmental Management, Vol. 19, No. 3, p 221-228, October, 1984. 3 Fig, 18 Ref.

Descriptors: *Bogs, *Vegetation, *Environmental effects, *Power transmission lines, Tewksbury, Massachusetts, Legal aspects, Ecosystems, Wetlands, Habitats, Wetlands management.

Wetland modification is strictly controlled by a number of state and federal statutes. This study documents the effects of construction and maintenance of power utility rights-of-way on shrub swamp-bog vegetation at Tewksburg, Massachusetts. Construction of the right-of-way created a single large-scale impact. Maintenance required a series of lesser, but repeated, perturbations. The construction and maintenance of power utility rights-of-way did not appear to be in conflict with the intent of wetlands protection laws. Neither activity created a long term or irreparable negative impact. In fact, the mosaic of habitat types which result from these practices increases the overall diversity of the landscape by encouraging equally diverse, but different, patches of vegetation. It should be noted, however, that a management program which is somewhat more conservative than the one practiced here until 1976 is likely to be equally effective from a management perspective, while causing less change to the plant association. Even the present management strategy did not appear to cause changes from which the vegetation could not recover naturally. (Baker-IVI)
W85-06606

AGRICULTURE IN CHINA - A DETERIORATING SITUATION,
Leiden Rijksuniversiteit (Netherlands). Sinological Inst.
E. B. Vermeer.
Ecologist, Vol. 14, No. 1, p 6-14, 1984. 2 Fig, 56 Ref.

Descriptors: *China (Peoples Republic), *Agriculture, Irrigation, Conservation, Erosion, Salinization, Deforestation, Water pollution, Oasis, Wetlands, Water supply.

Indications are that China's agricultural policies, in particular those pertaining to the bringing into production of marginal lands, have been environmentally disastrous. Erosion, salinization, deforestation, dessication as well as contamination of shrinking water supplies are all serious problems besetting China. The question as to whether marginal areas should be continued to be cultivated for foodgrain production or any crop at all has several angles: production, productivity, employment, capital requirement and conservation and environmental concerns. Specific areas discussed include a new oasis in Xinjiang with secondary salinization resulting, the Loess Plateau coupled with water and soil erosion, the Sanjiang Plain and accompanying drying up of marshes and pastures, the dessication of the marshes, water supply in Tainjin, reclamation of lakes, drainage of the lakes and resultant drops in fish populations, the Hainan Island and the result of slash and burn techniques. (Baker-IVI)
W85-06630

MEASUREMENT AND PREDICTION OF EVAPORATION FROM FORESTED AND AGRICULTURAL CATCHMENTS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2D.
W85-06666

PRIMARY PRODUCTIVITY AND SPATIAL STRUCTURE OF PHYTOLITHIC GROWTH IN STREAMS IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK, TENNESSEE,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W85-06793

EXAMINATION OF TIDAL FLATS, VOL. 2: IDENTIFIED VALUES REVIEW.
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W85-06895

EFFECT OF PEAT MINING ON FISH AND OTHER AQUATIC ORGANISMS IN THE UPPER MIDWEST.
Camp, Dresser and McKee, Inc., Milwaukee, WI. Environmental Sciences Div.
Available from the National Technical Information Service, Sprinfield, VA 22161 as PB83-127936. FWS/OBS-80/65, May 1981. Fish and Wildlife Service, Washington, DC. Office of Biological Services. 72 p, 6 Fig, 4 Tab, 147 Ref.

Descriptors: *Peat bogs, *Environmental effects, *Ecological effects, *Peat mining, *Fisheries, *Macroinvertebrates, *Literature reviews, *Aquatic animals, Bogs, Water resources development, Wetlands, Water quality control, Acidic water.

A review of the literature pertinent to peatlands and peat mining is given to determine the effects of peat mining on aquatic animal life. The surface waters in the Upper Midwest peatlands provide thriving and diverse fisheries. Diverse populations of macroinvertebrates are also present. Peat mining techniques involving drainage may cause additional inputs of peatland waters into downstream surface waters which decreases the pH and hardness of the receiving waters. Preliminary results from unpublished studies showed that P and N concentrations were higher in runoff from a peatland being mined by the milled method than from two undisturbed peatlands. Oxygen levels in waters receiving drainage from mined peat bogs may be lowered by increases in suspended solids. Since metals are readily adsorbed by peat, the mining of peat bogs may release high concentrations of metals into the environment. Mining may also increase the level of dissolved organics and color of waters receiving peat bog drainage. Hydraulic peat mining methods would increase turbidity and be deleterious to fish spawning areas. Measures to mitigate the effects of drainage methods of peat mining on the aquatic environment include biological surveys, site erosion control, channel protection, runoff control, water diversion, settling of

suspended solids, and neutralization. Data gaps on peat mining impacts show the need for faunal surveys, better mine designs, hydrological data and water quality data.
W85-06936

POSSIBLE EFFECTS OF FORESTRY ON INLAND WATERS OF TASMANIA; A REVIEW,
Forest Ecology Research Fund, Launceston (Australia).
F. B. Michaelis.
Environmental Conservation, Vol. 11, No. 4, p 331-343, Winter, 1984. 5 Fig, 2 Tab, 78 Ref.

Descriptors: *Forestry, *Environmental effects, *Road construction, *Tasmania, *Australia, Water quality, Water supply, Land use, Logging, Burning, Reviews, Water yield.

Tasmania has the highest proportion of forested land of any Australian state (about 41%). The effects of road-building, logging, burning, and forest regeneraton, on water quality and aquatic flora and fauna in Tasmania are reviewed. Only brief mention is made of deforestation, or of salvage of forest associated with hydroelectric developments. In general, road construction and maintenance increase water yield, reduce water quality, and modify the physical structure of streams, particularly at bridge sites. The impact of logging depends on the harvesting method used, the proportion of trees felled, the proportion of the catchment logged, and the precautions taken. The effects of burning Australian forests are poorly understood, but there are changes in water yield and a decrease in water quality. The possible biological effects of these forest operations on Tasmania's inland waters are far-reaching. (Baker-IVI)
W85-07145

4D. Watershed Protection

SOME PROBLEMS ABOUT THE SOIL EROSION IN THE VRANCEA SUBCARPATHIANS (QUELQUES PROBLEMES SUR L'EROSION DES SOLS DANS LES SUBCARPATES DE VRANCEA),
For primary bibliographic entry see Field 2J.
W85-06420

SEDIMENT PROBLEMS AND THEIR MANAGEMENT IN PENINSULAR MALAYSIA,
Drainage and Irrigation Dept., Kuala Lumpur (Malaysia).
C. S. Fatt.
Water International, Vol. 10, No. 1, p 3-6, March, 1985. 1 Tab.

Descriptors: *Malaysia, *Rivers, *Sedimentation, *Erosion control, Watershed protection, Silting, Legislation, Soil erosion, Suspended sediments, Sediment control, Land use.

In general, soils in Peninsular Malaysia are highly susceptible to erosion if the vegetation cover is removed. Rivers in Peninsular Malaysia under natural conditions were known to have stable regimes and carried low sediment loads. As a result of rapid development during the last few decades, river sediment loads have gravely increased and problems of soil erosion and sediment discharge have emerged as matters of national concern. It has been estimated that more than 80% of the suspended sediment load is caused by human activities in the catchments. The natural processes are described and different human activities, such as mining, timber logging, urbanization and infrastructural development, and agricultural development, which contribute to sediment generation are noted. The main types of sediment problem are erosion of catchments, erosion of river courses, sedimentation in reservoirs, silting of river channels, silting of river mouths, and high sediment concentration. Current sediment control measures include the passage of several pertinent pieces of legislation including the Waters Enactment of 1920, Mining Enactment of 1923, Forest Enactment of 1934, Land Conservation Act of 1960, National Land Code of 1965, Environmental Quality Act of 1974, and the Town Planning Act in 1976. Structural measures for control include river training, sediment interception and dredging operations. Four major types of constraint constitute the main obstables to the effective control of sedimentation problems: economic, institutional, social and technical constraints. (Baker-IVI)
W85-06541

RIVER SEDIMENTATION AND REMEDIAL MEASURES IN NEPAL,
National Planning Commission, Kathmandu (Nepal).
C. L. Shrestha.
Water International, Vol. 10, No. 1, p 14-17, March, 1985. 18 Ref.

Descriptors: *Erosion control, *Sedimentation, *Soil properties, *Nepal, Himalayan Mountains, Watershed management, Land use, Legislation, Institutional constraints, Public policy.

Excessive erosion and instability are the geological characteristics in Nepal which occupies a central segment of the Himalayan Mountain System. Land use must be determined in a fitting manner within the range of its capability. The three major river systems - the Karnali, the Gandaki and the Koshi and the monsoon-fed rivers originating in the middle mountain zone form the essential part of the Ganga System. The forest area recorded in 1983 was 3.8 million hectares, of which 2.9 million were in the hills, and the remaining 0.9 million in the terai. Hydrological observations were initially begun in 1961. Legislation, institutional arrangements and remedial measures undertaken to address the problem are reviewed. Conservation, management of the watersheds and proper land use are the only means of survival. Policies have been formulated and legislation enacted. Proliferation of new institutions and availability of external finances are at times confusing and result in negative effects. There is an increase in the gap between enunciations and institutional arrangements and implementation. Political commitment is the prime need of the hour for water resources development and management of river sedimentation. For this task the nation's scientists must be nurtured to bring about the evolution of regional undertakings and international cooperation or understanding. (Baker-IVI)
W85-06543

MANAGEMENT OF RIVER AND RESERVOIR SEDIMENTATION IN PAKISTAN,
Pakistan Forest Inst., Peshawar.
S. M. Khan.
Water International, Vol. 10, No. 1, p 18-21, March, 1985. 6 Ref.

Descriptors: *Pakistan, *Sedimentation, *Reservoirs, *Rivers, Sediment transport, Erosion control, Irrigation, Agriculture, Soil conservation, Watershed management, Developing countries.

Agriculture is the mainstay in Pakistan's economy. About 70-80% of agricultural production comes from the irrigated areas. Irrigation water comes from the northern mountain watersheds of Pakistan. For centuries these watersheds have undergone excessive felling of trees, cutting and even uprooting of vegetation, overgrazing, and unproductive cultivation on marginal lands. Damage to the vegetal cover has thus occurred with resultant accelerated soil removal. According to present policy of the Government, the Forest Department must assume direct responsibility for proper soil conservation measures within the Government-owned forests, and the Soil Conservation Organization in privately owned lands. Watershed practices being carried out include construction of silt trap dams, spillways, earthern bunds, water diversion channels, water ponds, digging of contour trenches, afforestation, grass planting in watercourses and on earthen bunds, gully-plugging, check-damming, construction and maintenance of terraces, water disposal from fields, planting of fruit trees and their pruning, stabilization of landslides, reseeding of grasses and planting of fodder, water spreading, growing shelter belts, and other steps. Major management problems center around central coordination and monitoring agency, training and research, monitoring project activities, anomaly in planning and executions, and lack of cooperation. Proposals for future planning and implementation are included. (Baker-IVI)
W85-06544

REGIONAL PRIORITIES FOR ABANDONED MINE RECLAMATION IN THE BLACKLICK CREEK WATERSHED, PENNSYLVANIA,
Georgia Univ., Athens. School of Environmental Design.
For primary bibliographic entry see Field 5G.
W85-06607

STREAM-WATERSHED RELATIONS IN THE MISSOURI OZARK PLATEAU PROVINCE,
Missouri Agricultural Experiment Station, Columbia.
For primary bibliographic entry see Field 6G.
W85-06620

EROSION ON VERY STONY FOREST SOIL DURING PHENOMENAL RAIN IN WEBSTER COUNTY, WEST VIRGINIA,
Northeastern Forest Experiment Station, Broomall, PA.
For primary bibliographic entry see Field 2J.
W85-06967

EVALUATION OF MEMBRANE-TYPE MATERIALS FOR STREAMBANK EROSION PROTECTION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
D. W. White.
Miscellaneous Paper GL-81-4, August 1981. Final Report. 113 p, 2 Fig, 6 Tab, 87 Photos, 14 Plates, 1 Append.

Descriptors: *Performance evaluation, *Erosion control, *Bank erosion, *Stream stabilization, *Membranes, *Materials testing, *Materials engineering, *Bank stabilization, Stream degradation, Embankments, Slope degradation, Soil erosion, Slope protection, Slope stability, Slope stabilization.

Laboratory and field tests were conducted to test the performance of new materials and construction techniques for preventing streambank erosion. The specific materials tested were: T15, laminated vinyl-coated nylon; T16, neoprene-coated nylon; Hypalon, synthetic rubber-coated 5 X 5 and 10 X 10 polyester scrim membranes; and Bidim C-34 and C38, spunbonded, continuous polyester filament filter fabrics. The construction techniques used to install the membranes along Durden Creek and the Big Black River were: a stepped membrane encapsulated soil layer (MESL), a blanket method where the membranes were draped over the slope of the banks and anchored along the edges in ditches, and MESL sections. Results showed that all membrane materials tested performed satisfactorily and with cost effectiveness during normal streamflows as long as the banks remained stable. It is recommended that membranes should be used to prevent erosion when installed as blankets, stepped MESL, or MESL sections, and that the type of installation method should be determined by the condition of the bank where protection is needed.
W85-06979

ENGINEERING GEOLOGY AND GEOMORPHOLOGY OF STREAMBANK EROSION; REPORT 2: YAZOO RIVER BASIN UPLANDS, MISSISSIPPI,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
For primary bibliographic entry see Field 2J.
W85-06996

TRADITIONAL APPROACH TO WATER SYSTEM O AND M,
Manchester Water Works, NH.
For primary bibliographic entry see Field 5F.
W85-07060

STREAMBANK STABILITY,
Owens (F.W.) and Associates, Inc., Louisville, KY.
For primary bibliographic entry see Field 2J.
W85-07082

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

NOTE ON A MEMBRANE FILTRATION METHOD FOR THE CONCENTRATION AND ENUMERATION OF BACTERIOPHAGES FROM WATER,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
R. N. Purdy, B. N. Dancer, M. J. Day, and D. J. Stickler.
Journal of Applied Bacteriology, Vol. 58, No. 2, p 231-233, February, 1985. 2 Tab, 5 Ref.

Descriptors: *Membrane filtration, *Membrane processes, *Bacteriophage, Viruses, Water analysis, Bacteria.

A membrane filtration method is described for the recovery and enumeration of bacteriophage from water. The method is conveniently used in the field and requires no complex or expensive equipment. Nine sources of water were sampled for use in the study: Roath Park Lake, River Taff, Llanishen Reservoir, Ogmore Beach, Rest Bay, River Thaw, Cosmeston Lake, River Ely, and Penarth Beach. Subsamples of the water types were inoculated with phage. Samples were treated with chloroform to reduce the indigenous bacterial flora. They were then filtered through glass fiber to remove any suspended solids that might block the membrane filters and mask plaque formation. Any phages associated with the solid material were eluted in nutrient broth and the eluate was passed through the filter to add to the filtrate. Samples were aerated to eliminate residual chloroform. Host cells were added and absorption of bacteriophage was allowed for at least 20 min at room temperature. Samples were passed through a cellulose nitrate membrane filter which was then incubated at 30 C overnight on nutrient agar. Plaques were displayed on the membrane by treating the cells with tetrazolium violet, 2.0 mg/ml. The membrane filtration method allowed the efficient recovery and enumeration of phages RP1015, RP1033, and RP1044 from 100 ml volumes of a diversity of water types. The method is convenient to use in the field. (Baker-IVI)
W85-06180

FIELD OBSERVATIONS ON THE OCCURRENCE OF NEW INDICATORS OF DISINFECTION EFFICIENCY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, B. F. Severin, D. Roy, R. S. Engelbrecht, and A. Lalchandani.
Water Research, Vol. 19, No. 3, p 323-329, 1985. 6 Fig, 5 Tab, 12 Ref.

Descriptors: *Bioindicators, *Disinfection, *Yeasts, *Acid-fast bacteria, Wastewater analysis, Water analysis, Coliforms, Bacteria, Enteroviruses.

The conventional coliform group of bacteria may be more sensitive to disinfectants than certain human enteric viruses. Acid-fast and yeast organisms are more resistant to free chlorine and inorganic chloramines than Poliovirus Type I (Mahoney) and Escherichia coli, making them potentially better indicators of disinfection efficiency than coliforms with respect to the inactivation of the more resistant enteric viruses. The presence of acid-fast and yeast organisms in wastewater and water treatment plants and in surface water was studied. These organisms satisfy three of Bonde's criteria for indicator organisms: presence whenever pathogens are likely to be present; resistance at least equal to that of pathogens; and lack of regrowth in the post-treatment environment. This, plus prior data, indicates that these organisms are at least as acceptable as the coliform group as indicators of disinfection efficiency. The judicious use of multiple indicators, including the acid-fast and yeast groups, may permit a more thorough assessment of microbial quality in many situations. (Moore-IVI)
W85-06224

DETECTION OF GIARDIA CYSTS AT LOW CONCENTRATIONS IN WATER USING NUCLEPORE MEMBRANES,
Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
P. M. Wallis, and J. M. Buchanan-Mappin.
Water Research, Vol. 19, No. 3, p 331-334, 1984. 4 Fig, 11 Ref.

Descriptors: *Giardia, *Membrane filtration, Water analysis, Pathogenic protozoa, Protozoa, Filtration.

A filtration procedure was devised to recover Giardia cysts from water using 5 micro-m Nuclepore membranes (110 mm in dia). Cysts taken from a beaver (Castor canadensis) were added to 100 l of untreated stream water and recovered by filtration. Cysts were washed from the membrane, concentrated by centrifugation and microscopically examined. Recovery efficiencies averaged 53% at cyst concentrations between 0.5 and 45 cysts/l. Maximum cyst recovery was observed at filtration pressures of 40-60 kPa. The advantages offered by this method over cartridge filtration methods include higher recovery efficiencies at low cyst concentrations and simpler, more rapid laboratory procedures. (Author's abstract)
W85-06225

ERRORS IN GRAN FUNCTION ANALYSIS OF TITRATION DATA FOR DILUTE ACIDIFIED WATER,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
T. E. Barnard, and J. J. Bisogni, Jr.
Water Research, Vol. 19, No. 3, p 393-399, 1985. 4 Fig, 4 Tab, 15 Ref.

Descriptors: *Titration, *Water analysis, *Acidity, *Gran function, Error analysis, Chemical reactions, Carbon dioxide, Surface waters.

Errors that result from applying simple Gran function analysis to titration data from typical dilute acidified surface waters are discussed. Theoretical development and experimental verification of these errors are presented. It is concluded that for dilute acidifed surface waters of the type found in the Adirondack region of New York and in Scandinavia, simple Gran function analysis of titration data will lead to the following errors. An overestimate of strong acid acidity results at the expense of an underestimate of weak acid acidity. This is a theoretical error and its magnitude is a function of the concentration and strength of the weak acids in the sample. The error may be reduced but not eliminated by adding additional strong acid in the sample and subtracting the amount added from the final result. An overestimate of total acidity may also result. This is an analytical problem that is due to a small amount of CO3(2-) (CO2) that is present in the titrant. This contaminant cannot be removed by purging either the sample or the titrant with nitrogen. (Baker-IVI)
W85-06231

INDIRECT DETERMINATION OF TRACE PHENOL IN WATER BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY,
East China Normal Univ., Shanghai. Dept. of Chemistry.
B.-X. Xu, T.-M. Xu, M.-N. Shen, and Y.-Z. Fang.
Talanta, Vol. 32, No. 3, p 215-217, March, 1985. 3 Tab, 6 Ref.

Descriptors: *Phenols, *Atomic absorption spectrophotometry, Pollutant identification, Water analysis.

An indirect method for determination of trace phenol in water by atomic-absorption spectrophotometry (AAS) is described. The phenol is brominated in acidic solution with KBrO3-KBr solution at room temperature. The excess of bromine is reacted with KI and the I2 produced is extracted into cyclohexane and then reduced back to I(-) with ascorbic acid. The I(-) is then complexed with Cd(2+) in sulfuric acid medium and the complex extracted into MIBK. The extract is analyzed by flame AAS for Cd (and hence indirectly for phenol). The linear concentration range for determination of phenol is 6 x 10 to the -7th to 0.9 x 10 to the -5th M aqueous solution. Several foreign ions and organic substances do not interfere. (Author's abstract)
W85-06251

PARTICLE DISCRIMINATION EFFECTS IN THE DETERMINATION OF TRACE METALS IN NATURAL FRESH WATERS,
Oslo Univ. (Norway). Inst. for Kjemi.
B. Salbu, H. E. Bjornstad, N. S. Lindstrom, E. M. Brevik, and J. P. Rambaek.
Analytica Chimica Acta, Vol. 167, p 161-170, January, 1985. 5 Fig, 14 Ref.

Descriptors: *Trace metals, *Particulate matter, *Water analysis, *Natural waters, Neutron activation analysis, Atomic absorption spectrometry, Plasma atomic emission spectrometry, Filtration, Metals.

Instrumental neutron activation analysis (i.n.a.a.), atomic absorption spectrometry (a.a.s.), and inductively-coupled plasma atomic emission spectrometry (i.c.p.a.e.s.) have been applied to the determination of Na, K, Mg, Ca, Al, Mn, Fe and Zn in fresh waters containing naturally occurring particles. Scattered results were obtained for the total concentrations of trace metals which were associated to some extent with particles retainable by 0.45-micro-m filter membranes. Particle discrimination effects are indicated and the fraction of elements included in the final result depends on the method used. For the simultaneous determination of the total concentrations of Al, Mn, Fe and Zn, i.n.a.a. is preferred, as all element fractions present are included in the result. When a.a.s. or i.c.p.a.e.s. is applied, lower results are obtained when particulate matter is present, the results referring only to the acid-soluble low-molecular-weight fraction (< or = 0.45 micro-m diameter). When particles are removed prior to the quantifying step, the results obtained on the filtrates by all methods are in good agreement. However, considering the low concentrations of several elements in separated fractions, i.n.a.a. is most favorable for the determination of aluminum while graphite-furnace a.a.s. is most suitable for zinc. Both methods are applicable for manganese. For Ca, Fe, K, Mg and Na, i.c.p.a.e.s. is recommended. (Author's abstract)
W85-06252

USE OF THE L'VOV PLATFORM AND MOLYBDENUM COATING FOR THE DETERMINATION OF VOLATILE ELEMENTS IN THERMOMINERAL WATERS BY ATOMIC ABSORPTION SPECTROMETRY,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
A. Criaud, and C. Fouillac.
Analytica Chimica Acta, Vol. 67, p 257-267, January, 1985. 8 Fig, 4 Tab, 24 Ref.

Descriptors: *Mineral water, *Water analysis, *Atomic absorption spectrometry, *L'vov platform, Chemical composition, Arsenic, Antimony, Cadmium, Selenium, Germanium.

Arsenic, antimony, cadmium, selenium and germanium were determined in iron-rich spring-water samples with the use of a molybdenum-coated L'vov platform. With this method, iron spectral interference effects were eliminated without the use of Zeeman effect background correction. Analytical sensitivities of 1 micro-g/l and an r.s.d. of 2-3% were obtained. Only germanium could not be determined directly, but required the use of standard addition. Selenium concentration in the samples were below the detection limit. (Author's abstract)
W85-06253

DIFFERENTIAL PULSE POLAROGRAPHIC DETERMINATION OF NITRILOTRIACETIC ACID IN NATURAL WATERS AND WASTE WATER EFFLUENTS,
Istituto Guido Danegani S.p.A., Novara (Italy).
F. Guerrieri, and G. Bucci.
Analytical Chimica Acta, Vol. 167, p 393-397, January, 1985. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Differential pulse polarography, *Nitrilotriacetic acid, Wastewater analysis, Water analysis, Iron, Aluminum, Polarography.

Optimal conditions are reported for a correct determination of nitrilotriacetic acid (NTA) with differential pulse polarography and Bi(III) in the presence of iron(III) and aluminium(III). The limit of determination of the method is improved from 20 to 2 micro-g/l NTA by ten-fold concentration of the sample. A method is proposed to obtain a reference polarogram by using the sample under test and masking NTA as its Al(III) complex. For the analysis of wastewaters, a reference polarogram is recorded directly for the sample and is used to correct for interfering organic substances. In order to determine NTA with Bi(III) in the presence of Fe(III), it is necessary to reduce Fe(III) to Fe(II). This reduction can be achieved at 20 C and pH 2 by adding hydroxylamine or ascorbic acid immediately before polarography, or only hydroxylamine at 90-100 C and pH 3.3 before polarography, or only hydroxylamine at 90-100 C and pH 3.3. (Baker-IVI)
W85-06254

GAS CHROMATOGRAPY/MASS SPECTROMETRY DETERMINATION OF WATER-SOLUBLE PRIMARY AMINES AS THEIR PENTAFLUOROBENZALDEHYDE IMINES,
Ames Lab., IA.
M. J. Avery, and G. A. Junk.
Analytical Chemistry, Vol. 57, No. 4, p 790-792, April, 1985. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Water analysis, *Amines, *Pentafluorobenzaldehyde, *Gas chromatography, *Mass spectrometry, Chemical analysis, Water quality control, Organic compounds, Aliphatic amines, Imines.

Primary aliphatic amines present in various liquids is an important problem. These compounds can be found in biological fluids, environmental samples, and industrial process streams, usually in aqueous solutions and often at trace levels. Amines are difficult to extract from water and are not easily chromatographed due to their polarity. A new procedure is described to determine trace levels of primary aliphatic amines in aqueous solutions. It involves direct derivatization of the amines present in the water sample using pentafluorobenzaldehyde to form imines of the amines. The procedure requires minimal sample manipulation and is completed within 30 min and the imine derivatives can be readily extracted into hexane. High resolution gas chromatography/mass spectrometry analysis of the hexane extract is used to ensure that all imine isomers will be measured separately, with no interferences. (Baker-IVI)
W85-06255

DETERMINATION OF CHLORINATED BENZENES IN BOTTOM SEDIMENT SAMPLES BY WCOT COLUMN GAS CHROMATOGRAPHY,
National Water Research Inst., Burlington (Ontario).
F. I. Onuska, and K. A. Terry.
Analytical Chemistry, Vol. 57, No. 4, p 801-805, April, 1985. 3 Fig, 8 Tab, 13 Ref.

Descriptors: *Gas chromatography, *Chlorinated benzenes, *Sediments, Benzenes, Chlorinated hydrocarbons, Pollutant identification.

An integrated analytical procedure for determining chlorinated benzene contaminants that enables quantitation of individual isomers as low as 0.4 micro-g/kg in sediment samples has been developed. Preparation of the sample can be performed by using one of three techniques, namely, Soxhlet extraction and ultrasonic extraction or steam distillation. Chlorinated benzenes are then characterized and quantified by open tubular column gas chromatography with electron capture detection. Recoveries of individual chlorinated benzene isomers at three different levels from two different types of sediment, one low and one high in organic matter, were evaluated. Although all three methods are quantitative, the steam distillation method was found to be the most efficient for the determination, insofar as time and simplicity are concerned. Data presented indicate that detection limits of this method are 0.4 to 10 micro-g/kg of individual chlorobenzene isomers. Chlorobenzene recovery from bottom sediment samples at concentration levels between 1 and 100 micro-g/kg is 86 +/- 14%. (Author's abstract)
W85-06256

INDUSTRIAL WASTEWATER ANALYSIS BY LIQUID CHROMATOGRAPHY WITH PRECOLUMN TECHNOLOGY AND DIODE-ARRAY DETECTION,
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
M. W. F. Nielen, U. A. Th. Brinkman, and R. W. Frei.
Analytical Chemistry, Vol. 57, No. 4, p 806-810, April, 1985. 7 Fig, 4 Tab, 14 Ref.

Descriptors: *Wastewater analysis, *Liquid chromatography, *Industrial wastewater, Diode-array detection, Pollutant identification, Precolumns.

Small precolumns packed with C18, PRP1, and cation-exchange materials have been used for the on-line group separation and trace enrichment of industrial wastewater samples. The sample is divided into three main groups: a fraction containing nonpolar compounds, a second fraction containing medium polarity compounds and certain polar substituted aromatics, and a third fraction containing polar anilines and other polar bases. Each precolumn fraction is subsequently chromatographed on a C18 analytical column with a methanol gradient and detected by a diode-array UV-Vis detector. Multisignal plots and three-dimensional spectrochromatograms are used to get information about the identity of the pollutants present. The completely automated system is optimized for 29 selected chemicals of particular interest. Some of these compounds were found in the wastewater samples tested and were quantitated. (Author's abstract)
W85-06257

METHOD OF ANALYSIS BY THIN-LAYER CHROMATOGRAPHY FOR ACTIVE COMPONENTS OF TRIAZINE HERBICIDES IN WATER (DUNNSCHICHTCHROMATOGRAPHISCHE ANALYSENMETHODE FUR HERBIZIDE TRIAZIN-WIRKSTOFFE IM WASSER),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
A. Lawrenz.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 347-350, 1983. 2 Tab.

Descriptors: *Thin-layer chromatography, *Herbicides, *Triazines, *Pollutant identification, Water analysis, Simazine, Atrazine, Propazine, Desmetryn, Ametryn, Prometryn.

An analytical method for the semiquantitative determination in groundwater and lightly polluted surface waters of simazine, atrazine, propazine, desmetryn, ametryn, and prometryn is described. After extraction of the substances from the water sample, qualitative determination is performed by means of thin-layer chromatography. Chromatography is achieved with paraffin/glacial acetic acid/benzol/cyclohexane (10 + 20 + 30 + 200) in a saturated atmosphere in the chamber. Development is complete after a 12-cm run length, whereupon the slide is placed in a chlorinating atmosphere. The slide is then left in air for 10 min to remove excess chlorine, after which it is sprayed with o-tolodine reagent. The investigated substances appear as blue patches on a white background and must be evaluated immediately. Additional separation media may be used to confirm the identity of a substance. If silver nitrate is applied and the chromatogram irradiated by UV light for 10 min, chlorine-containing triazines appear as brown or black patches, while triazines containing sulfur appear white. p-Dimethylaminobenzaldehyde may be used as a negative test. Semiquantative determination is performed by visual comparison of patches (size and color intensity) with known concentrations of comparison substances. (Gish-IVI)
W85-06265

PROBLEMS IN WATER CONTAMINATION AND ITS ANALYTICAL UNDERSTANDING (PROBLEME DER WASSERKONTAMINATION UND IHRER ANALYTISCHEN ERFASSUNG),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
R. Koch, H. J. Dobberkau, D. Lienig, A. Lawerenz, and E. Stottmeister.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 391-399, 1983. 1 Tab, 22 Ref.

Descriptors: *Pollutant identification, *Raw water, Organic compounds, Water analysis, Chemical composition, Water treatment, Water quality standards.

The increasing loading of raw water for the drinking water supply with trace substances results in an increasing exposure of the population to toxicologically suspect substances. At present, the quality of such raw waters is evaluated mainly by cumulative parameters or individual substances with low ecotoxicological or human toxicological relevance. Now, about 500,000 environment-relevant organic substances must be taken into account; the number of individual compounds for a loaded receiving water is estimated to be 1000. Secondary contaminations are caused by oxidative processes of water treatment. In the trace substance analysis so far only about 40% of the organic substances are identifiable by comparatively simple methods. From this derives the demand for developing standardized methods for determining cumulative and group parameters with a high value of information and indication, as e.g. organically bonded chlorine or halogens. (Author's abstract)
W85-06267

ACUTE TOXICITY OF PHENOL, PENTACHLOROPHENOL AND SODIUM PENTACHLOROPHENATE TO A FRESHWATER OSTRACOD CYPRIS SUBGLOBOSA (SOWERBY),
Udaipur Univ. (India). Dept. of Limnology and Fisheries.
For primary bibliographic entry see Field 5C.
W85-06271

TOXICITY AND TRACE ANALYSIS OF TENSIDES IN WATER (ZUR TOXIZITAT UND SPURENANALYSE VON TENSIDEN IN WASSER),
Akademie der Wissenschaften der DDR, Leipzig. Forschungsstelle fuer Chemische Toxikologie.
G. Hanschmann, and H. Sohr.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 5, p 497-509, 1983. 4 Fig, 1 Tab, 53 Ref.

Descriptors: *Tensides, *Toxicity, *Water analysis, Bioaccumulation, Infrared spectroscopy, Thin-layer chromatography, Sediments, Pollutant identification, Water pollution effects, Surfactants.

Judging the behavior of tensides in water requires not only the results of the conventional methods of determining their biochemical degradability and toxicity, but also their distribution in the sediment as well as in animal and vegetable products. Properties such as adsorbability, persistence, sequence of stations in the nutrient chain (bioaccumulation), relations of structure and actions and dose-effect relations are very important. In these investigations, changes in the effects of combinations of substances with tensides have to be taken into account; a power plant water and a Baltic Sea sediment are used as examples. Of the variety of tested possibilities of analyzing very small amounts of tensides, mainly infrared spectroscopy and thin-layer chromatography have proved to be success-

ful. By means of special procedures, the detection and the quantitative determinability can be shifted into the nano- and picogram-ranges. (Author's abstract)
W85-06272

OPTIMAL SAMPLING STRATEGIES FOR SOURCE IDENTIFICATION IN ENVIRONMENTAL EPISODES,
Iowa Univ., Iowa City. Dept. of Geography.
R. Rajagopal.
Environmental Monitoring and Assessment, Vol. 4, No. 1, p 1-14, March, 1984. 4 Fig, 7 Tab, 14 Ref.

Descriptors: *Sampling, *Water analysis, *Optimization, *Water pollution sources, Streams, Toxicity, Mathematical studies.

A mathematical framework for the design of optimal sampling strategies for episode detection in a stream network is developed. The methodology is readily applicable to conservative contaminants that do not undergo significant changes. It can be extended to cases of non-conservative contaminants, if one is able to model the behavior of such contaminants in stream networks and incorporate such knowledge in interpreting sample results. The methodology can be extended to cases where there are a large number of sources on a stream network. The cost effective nature of such sampling plans depends on the ability to accurately estimate certain values. The application of some of the sampling strategies developed to the case of a toxic contaminant release in a sewerage system is briefly explored. (Baker-IVI)
W85-06283

TOXIC SUBSTANCES MONITORING PROGRAM, 1982,
California State Water Resources Control Board, Sacramento.
F. La Caro, and D. Watkins.
Water Quality Monitoring Report No. 83-7TS. December 1983, 124 p, 10 Fig, 14 Tab, 10 Ref, 6 Append.

Descriptors: *Toxicity, *Heavy metals, *Water pollution sources, *Water pollution effects, Water sampling, On-site data collections, Dieldrin, Mercury, Cadmium, Copper, Lead, Poisons, Water pollution, *Toxaphene, Guadalupe River, Lake Nacimiento, Feather River, Stanislaus River, Alamo River, New River, PCB.

The results are presented of the the 1982 sampling of the occurrence and levels of toxic substrates in the fresh water of California. The analysis of 2,580 samples showed that in 482 instances concentrations of toxic substances were detected, identified and measured. In 39 instances, the concentrations measured exceeded the National Academy of Science (NAS) guidelines. Twenty-two of these instances involved mercury. Mercury concentrations exceeded the Food and Drug Administration action level at the Guadalupe River in Region 2 and Lake Nacimiento in Region 3. The rest of the NAS guideline violations involved chlordane, DDT, dieldrin, hexacholorcyclohexane (HCH) and toxaphene. Other substances found in elevated concentrations were copper, cadmium, lead, silver, zinc, hexachlorobenzene, and PCBs. Toxaphene was detected at levels exceeding the NAS guideline in five rivers, including the Feather and the Stanislaus, marking the first time detectable levels of toxaphene were noted in these rivers. Levels in the Alamo River fish surpassed NAS guidelines for DDT, Dieldrin and toxaphene. Levels in New River fish exceeded the NAS guidelines for DDT, hexachlorocyclohexande (HCH-Beta) and toxaphene. At present, adsorbent column water sampling may not yield sufficient cost-effective data to be helpful in determining a potential water quality problem area. This type of analysis should be stopped until such techniques improve. (Hawkins-Omniplan)
W85-06329

USING A BIOTIC INDEX TO EVALUATE WATER QUALITY IN STREAMS,
Wisconsin Dept. of Natural Resources, Madison.
W. L. Hilsenhoff.
Technical Bulletin No. 132, 1982, 22 p, 15 Fig, 6 Tab, 27 Ref.

Descriptors: *Stream biota, *Bioindicators, *Water quality, *Stream pollution, *Aquatic Life, *Water sampling, *Biological samples, *Pollutant identification, Species composition, Streams, Mathematical equations, Biotic index.

A biotic index proposed in 1977 has been used widely in Wisconsin and elsewhere to evaluate the water quality of streams. More than 1,000 streams have been evaluated in Wisconsin. Recent improvements in the index and keys for identification of species in certain important insect genera are included in this report. For the purpose of calculating a biotic index, species are assigned pollution tolerance values of 0 to 5 on the basis of previous field studies. Intermediate values are assigned to species that occur in streams with intermediate degrees of pollution or disturbance. When species cannot be identified, genera are assigned values instead. The biotic index is calulated from a formula which includes the number of individuals of each species or genus, the tolerance value assigned to that species or genus, and the total number of individuals in the sample. Several studies were carried out to determine the efficiency and reliability of this procedure, the importance of species identification, and the relative merit of alternative sampling and sorting procedures. The time required to collect a sample, sort it, identify the arthropods to genus, label the vials, and calculate a biotic index was only slightly more than one hour for each stream. Only 21 more minutes were needed to calculate a biotic index at the species level. A recommended sampling procedure along with alternative methods are given. (Hawkins-Omniplan)
W85-06339

SPONGE SENTINEL OF HEAVY METALS,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
B. Patel, M. C. Balani, and S. Patel.
Science of the Total Environment, Vol. 41, No. 2, p 143-152, February, 1985. 2 Fig, 2 Tab, 30 Ref.

Descriptors: *Heavy metals, *Monitoring, *Water quality control, *Sponges, Bioindicators, Trace metals, Organic compounds, Halogens, Manganese, Nickel, Zinc, Cobalt, Selenium, Tin, Strontium, Iodine, Cesium.

The possibility of monitoring siliceous sponges as an ideal bioindicator of 17 trace metals and halogens was investigated. Of the two species of Demosponge from the Indian coastal waters receiving stable and radioactive nuclides (54-Mn, 63-Ni, 65-Zn, 60-Co, 75-Se, 113-Sn, 90-Sr, 131-I, 137-Cs), Spirastrella cuspidifera was found to accumulate Cd, Cr, and Sn in a range of 15-2000 microg/g dry tissue, some 5-7 orders of magnitude higher than in the ambient waters. Prostylyssa foetida, from the same microecological niche, was found to be totally free of these three metal ions. The bioaccumulation of Ni was also significantly higher in S. cuspidifera (400-2250 microg/g) than in P. foetida (7-15 microg/g). The former species was also an ideal sentinel for detecting levels of Co, Zn, and Ti; levels of Cu, Mn, Pb, Fe and Sr were higher in P. foetida, but those of the halogens I and Br were practically identical in both species. Furthermore, bioaccumulation of metal ions was found to be a function of sponge tissue itself, rather than that of either obligate or facultative symbiont microflora. In view of the high degree of species specificity which sponges exhibit while accumulating many trace metal ions, a sponge watch program is proposed on a global scale for monitoring the health of coastal ecosystems against a variety of potentially toxic pollutants. (Author's abstract)
W85-06431

ALGAL ASSAY EVALUATION OF TRACE CONTAMINANTS IN SURFACE WATER USING THE NONIONIC SURFACTANT, TRITON X-100,
Ontario Ministry of the Environment, Rexdale. Water Resources Branch.
S. L. Wong.
Aquatic Toxicology, Vol. 6, No. 2, p 115-131, March, 1985. 7 Fig, 2 Tab, 43 Ref.

Descriptors: *Algal growth, *Organic compounds, *Toxicity, *Triton X-100, Surfactants, Water quality control, Pollutant identification.

Triton X-100, a nonionic surfactant, has been found to be capable of neutralizing the toxic effect of selected organic compounds in algal assays using 10% Bristol's medium. This nonionic surfactant does not seem to affect specific growth rates of Chlorella cultures when it is added alone to the medium but it accelerates growth inhibition when coupled with metals. By administering a series of increasing Triton concentrations in assays with natural waters, Chlorella growth that was once arrested in the test waters became revitalized and growth was more profuse as the concentration of Triton increased. The results indicate that Triton has the ability to alleviate the toxic stresses of organic mixtures that are contaminating many southern Ontario lakes. The bioavailability of these trace organics such as PCB, DDT, chlordane and dieldrin was confirmed in the study lake waters from bioaccumulation in fish tissues. (Author's abstract)
W85-06438

USE OF FISH CELL CULTURES AS AN INDICATION OF CONTAMINANT TOXICITY TO FISH,
Waterloo Univ. (Ontario). Dept. of Biology.
N. C. Bols, S. A. Boliska, D. G. Dixon, P. V. Hodson, and K. L. E. Kaiser.
Aquatic Toxicology, Vol. 6, No. 2, p 147-155, March, 1985. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Toxicity, *Fish, *Organic compounds, *Phenols, Water quality control, Bioindicators.

The cytotoxicity of 12 chemicals to rainbow trout cells (RTG-2) was determined in culture. The indicator of cytotoxicity was the inability of cells to attach to a growth surface after chemical exposure. From most toxic to least toxic, these chemicals were pentachlorophenol, p-methylaminophenol, 2,4-dichlorophenol, p-chlorophenol, p-cyanophenol, p-nitrophenol, benzene, p-methylphenol, aniline, phenol, p-methoxyphenol, and 1,2,4-trichlorobenzene. The cytotoxicity of these compounds was found to be significantly correlated to their water-born toxicity to rainbow trout. (Author's abstract)
W85-06440

ION-SCANNING POTENTIOMETRY-A METHOD FOR DETERMINATION OF ZINC, CADMIUM, LEAD AND COPPER TRACES IN MARINE AND INTERSTITIAL WATER (ION-SKANIRUYUSHCHAYA POTENTSIOMETRIYA - METOD OPREDELENIYA MALYKH KOLICHESTV TSINKA, KADMIYA, SVINTSA I MEDI V MORSKOII ILOVOI VODE),
A. E. Kosov, and G. I. Sychkova.
Okeanologiya, Vol. 24, No. 1, p 88-94, January/February, 1984. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Metals, *Water analysis, *Interstitial water, *Seawater, Potentiometers, Zinc, Cadmium, Copper, Lead.

Use of an ion-scanning potentiometry method to study marine and interstitial water is demonstrated. The optimum conditions for the measurements are noted. The lower limit of detection for cadmium, lead and copper determinations are as low as 0.05 microg/l. The thickness of the mercuric film formed at the working electride surface on zinc and copper and its possible effect on the results of the determinations is studied, and simple methods are proposed to measure concentrations of these metals when they appear together in solution. (Author's abstract)
W85-06454

FORMS OF COPPER MIGRATION IN FRESH AND BRACKISH WATER BODIES (FORMY

MIGRATSII MEDI V PRESNYKH I SOLONOVATOVODNYKH VODOEMAKH),
V. M. Timchenko, and P. V. Sipchenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 69-75, 1984. 2 Fig, 1 Tab, 21 Ref.

Descriptors: *Copper, *Water analysis, *Membrane filters, Chromatography, Chemoluminescence, Brackish water, Natural waters.

The kinetic chemoluminescent method and techniques of membrane filtration and gel chromatography have been employed to study the state of copper in fresh and brakish water bodies. Copper complexing was very high, 70-90% Cu(solv). The distribution of copper between its complexed compounds is featured by a rather great variety, with compounds having a molecular mass of 0.25-5 thou. being the most abundant among the complex forms. (Author's abstract)
W85-06463

UTILIZATION OF CRUSTACEA ZOOPLANKTON FOR ESTIMATING HEAVY METAL POLLUTION OF LAKE BALATON (ISPOL'ZOVANIE RACHKOVOGO ZOOPLANKTONA (CRUSTACEA) DLYA OTSENKI ZAGRYAZNENIYA OZ. BALATON TYAZHELYMI METALLAD),
K. V. Balogh, and J. Salanki.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 56-64, 1984. 11 Fig, 1 Tab, 19 Ref.

Descriptors: *Lake Balaton, *Heavy metals, *Bioindicators, *Zooplankton, Mercury, Cadmium, Lead, Copper, Iron, Manganese, Zinc, Crustaceans, Seasonal variation.

Lake Balaton was sampled at 15 sites for concentrations of various heavy metals (mercury, cadmium, lead, copper, iron, manganese and zinc) in Crustacea zooplankton. The north-western part of the lake is more polluted than other areas. Heavy metals are more likely to enter the lake in summer. (Author's abstract)
W85-06469

APPLICATION OF ANALYZER A PHI-1 TO QUANTITATIVE DETERMINATION OF BLUE-GREEN ALGAL TOXINS (ISPOL'ZOVANIE PRIBORA AF-1 DLYA KOLICHESTOVENNOGO OPREDELENIYA TOKSINOV SINEZELENYKH VODOROSLEI),
N. I. Kirpenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 81-83, 1984. 2 Fig.

Descriptors: *Enzymatic activity analyzer, *Toxins, *Cyanophyta, Water analysis, Water quality control, Eutrophication, Pollutant identification, Public health.

The enzymatic activity analyzer A Phi-1 is described for application in quantitative determination of toxins from blue-green algae. The procedure can be used by hydrobiological specialists, hygienists, and sanitary and epidemiologic stations for controlling water quality during blue-green algal blooms in bodies of water. (Author's abstract)
W85-06472

METHODOLOGICAL PRINCIPLES FOR ECOLOGICAL CLASSIFICATION OF SURFACE WATER QUALITY (O METODOLOGICHESKIKH OSNOVAKH EKOLOGICHESKOI KLASSIFIKATSII KACHESTVA POVERKHNOSTNYKH VOD SUSHI),
V. R. Lozansky.
Gidrobiologischeski Zhurnal, Vol. 20, No. 3, p 39-42, 1984. 13 Ref.

Descriptors: *Water quality, *Surface waters, Ecology, Water quality standards, Ecosystems.

The paper is open to discussion. A disagreement is expressed with the interpretation of the notion of 'water quality' and criteria for estimation of the surface water quality by V. N. Zhukinsky and O. P. Oksiyuk, the authors of ecological classification of the land surface water quality (see Gidrobiologischeski Zhurnal, No. 2, 1981; No. 2, 1983). It is affirmed that water quality criteria correctly formulated in ecological sense and ecological norms of water quality constructed on their basis must be used for preservation and formation of ecosystems useful for the society. Neglecting this, it is impossible to make a single complex ecosystem classification for estimating quality of the surface waters. (Author's abstract)
W85-06473

NECESSITY OF CREATION OF UNIVERSAL WATER QUALITY CLASSIFICATION (O NEOBKHODIMOSTI SOZDANIYA UNIVERSAL'NOI KLASSIFIKATSII KACHESTVA VOD),
A. V. Dyachkov.
Gidrobiologischeski Zhurnal, Vol. 20, No. 3, p 43-45, 1984. 9 Ref.

Descriptors: *Water quality standards, Water resources development, Surface waters, Ecosystems.

Any national-economic utilization of water resources should provide either conservation or restoration of biological value of water bodies. A system of standards directed to the priority of hydrobiological classification of all the waters promotes this cause. (Author's abstract)
W85-06474

TECHNIQUE FOR PHOSPHORORGANIC INSECTICIDE DETECTION IN WATER AND HYDROBIONTS (METOD OBNARUZHENIYA FOSFORORGANICHESKIKH INSEKTITSIDOV V VODE I GIDROBIONTAKH),
V. V. Metelev.
Gidrobiologischeski Zhurnal, Vol. 20, No. 6, p 77-80, 1984. 3 Ref.

Descriptors: *Insecticides, *Organophosphorus compounds, *Aquatic animals, Enzyme methods, Pollutant identification, Water analysis.

A simple high-sensitive method is developed for detecting organophosphoric compounds in water and in aquatic animals. The method is based on the enzymic paper determination with the preliminary activation of phionic phosphates in hydrogen peroxide vapors and on development by an enzymic developer. (Author's abstract)
W85-06485

SURROGATE PARAMETERS FOR MONITORING ORGANIC MATTER AND THM PRECURSORS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W85-06491

ORGANIC HALOGEN MEASUREMENTS: CURRENT USES AND FUTURE PROSPECTS,
Environmental Protection Agency, Cincinnati, OH.
A. A. Stevens, R. C. Dressman, R. K. Sorrell, and H. J. Brass.
Journal of the American Water Works Association, Vol. 77, No. 4, p 146-154, April, 1985. 3 Fig, 8 Tab, 39 Refs.

Descriptors: *Water analysis, *Halogenated hydrocarbons, *Water quality control, *Drinking water, Water treatment, Wastewater treatment, Disinfection, Pollutant identification.

Currently, the most popular method of analyzing total organic halide in water involves carbon adsorption, oxidative combustion, and measurement of the hydrogen halide by microcoulometry. Total organic halide (TOX) can be used as an indicator of water quality, providing a direct measure of disinfection by-product formation and, in some circumstances, a surrogate measure of individual organic pollutants. An important application of organic halide (OX) measurements is in unit process design, control, and monitoring. Measurements of OX in wastewater primarily discern compounds of industrial origin, whereas analysis of OX in finished drinking water primarily discern disinfection by-products. Trihalomethanes and nonpurgeable organic halide (NPOX) data generated under carefully controlled treatment conditions can lead to a plant design that minimizes the formation of halogenated disinfection by-products in the treated water. In spite of several shortcomings, the TOX method has a unique advantage in that it can verify the absence of OX contamination without the need to resort to a variety of specific methods to eliminate all the possibilities. Costs can be saved by using a single method to monitor a situation in which two or more methods might otherwise be required. (Baker-IVI)
W85-06494

EFFECT OF ENVIRONMENTAL PARAMETERS ON LYSOSOMAL MARKER ENZYMES IN THE TROPICAL BLOOD CLAM ANADARA GRANOSA,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
For primary bibliographic entry see Field 5C.
W85-06522

CRYPTOGAMS OF FLOWING WATERS - BIOINDICATORS OF WATER QUALITY (FLIESSGEWASSERKRYPTOGAMEN - BIOINDIKATOREN DER WASSERQUALITAT),
Martin-Luther-Univ. Halle-Wittenberg, Halle (German D.R.).
U. V. Kock.
Wissenschaftliche Zeitschrift, Vol. 34, No. 1, p 95-104, 1985. 1 Fig, 1 Tab, 77 Ref.

Descriptors: *Aquatic plants, *Bioindicators, *Cryptogams, *Water quality, Algae, Mosses, Lichens, Streams, Ecological distribution.

The paper deals with investigations for using aquatic cryptogams as bioindicators of water quality. This is necessary especially for such rills and small rivers in which only a few species of higher water plants in small quantities can occur because of the special abiotic factors. The investigations were carried out on two softwater rills flowing to the Saidenbach-water reservoir (Ore mountains; Karl-Marx-Stadt district; Germany Democratic Republic). This organism group (green and red algae, mosses, lichens) can be used for ranking such waters in so-called 'floristic-ecological zones' of distinct water quality. (Author's abstract)
W85-06525

RECOVERY AND REPRODUCIBILITY IN DETERMINATION OF VOLATILE HALOCARBONS IN WATER AND BLOOD,
Turku Univ. (Finland). Dept. of Public Health.
R. Kroneld.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 4, p 486-496, April, 1985. 6 Tab, 9 Ref.

Descriptors: *Chemical analysis, *Blood, *Water analysis, *Halogenated hydrocarbons, *Volatile compounds, Pollutant identification, Organic compounds.

The recovery or extraction efficiency of volatile halocarbons from water and both plasma and blood cells was analyzed. The recovery in water is described as a function of amount of n-pentane used as an extraction solvent. There was a highly significant increase in the eluation process to 5 and 10 ml, but the increase was not significant from 5 to 10 ml. Evidently a water:pentane ratio lower than 20 means a dilution of the extract. The recovery as a function of extraction time in water was also analyzed. There was a significant increase in the eluation process to 5 and 10 minutes. Continued extraction or shaking of the test tubes for more than 5 minutes did not evidently increase the recovery in a significant way. The recovery as a function of extractions from plasma and cells was also analyzed. There was a significant increase in eluation to an extraction number of 80, 100, and 150, both in plasma and cells. Turning the test tube until the phase had been passed through the tube did not significantly increase the recovery. (Baker-IVI)

W85-06526

SIMULTANEOUS DETERMINATION OF ARSENIC, SELENIUM, TIN AND MERCURY BY NON-DISPERSIVE ATOMIC FLUORESCENCE SPECTROMETRY,
Consiglio Nazionale delle Richerche, Pisa (Italy). Ist. di Chimica Analitica Strumentale.
A. D'Ulivo, R. Fuoco, and P. Papoff.
Talanta, Vol. 32, No. 2, p 103-109, February, 1985. 6 Fig, 5 Tab, 28 Ref.

Descriptors: *Arsenic, *Tin, *Mercury, *Selenium, *Atomic fluorescence spectrometry, Chemical analysis, Heavy metals, Pollutant identification, Spectrometry.

A non-dispersive atomic-fluorescence spectrometry procedure is described for simultaneous determination of arsenic, selenium, tin and mercury in aqueous solution. Radiofrequency-excited electrodeless discharge lamps 100% modulated in the kHz region, were used for atom excitation. Sodium tetrahydroborate was used as reductant and a hydrogen-argon miniflame as atomizer. Sample volumes from 0.2 to 5 ml can be used. The lowest detection limit is obtained with 5 ml of sample for selenium and arsenic and either 1 or 5 ml of sample for mercury and tin. Except for determination of selenium and arsenic at concentrations near the detection limit, 1 ml of sample is to be preferred because the interferences are then minimal. The relative standard deviation is then less than 7% for each of the four analytes within their dynamic ranges and down to 1 ng/ml, regardless of the presence of high concentrations of the other three analytes. The linear dynamic ranges cover more than three orders of magnitude for all four analytes. (Baker-IVI)
W85-06570

SPECTROPHOTOMETRIC DETERMINATION OF NITRATE AND NITRITE IN NATURAL WATER AND SEA-WATER,
Loyola Univ. of Chicago, IL. Dept. of Chemistry.
S. J. Bajic, and B. Jaselskis.
Talanta, Vol. 32, No. 2, p 115-118, February, 1985. 1 Fig, 2 Tab, 33 Ref.

Descriptors: *Nitrates, *Nitrites, *Spectrophotometry, Water analysis, Sea water, Natural water, Pollutant identification.

Nitrate and nitrite in natural waters are determined spectrophotometrically by passage through an amalgamated zinc reductor at pH 3.4 into iron(III)-Ferrozine solution. Interference by high levels of nitrite is eliminated by treatment with azide. The method is based on hydroxylamine (resulting from initial reduction of nitrate or nitrite) reducing iron(III)to give the intensely colored iron(II)-Ferrozine complex, the absorbance of which is proportional to the original amount of nitrate (or nitrite). The pH must be kept between 3.2 and 3.5, and sodium chloride should be added to provide a higher ionic strength and give more reproducible results. This method is particularly suitable for the determination of nitrate in the presence of large amounts of nitrite and of chloride, at levels as low as 0.1 ppm with a relative precision of better than 3%. Synthetic sea water samples used in this study yielded consistently high blank values, which were primarily due to the nitrate impurities in the reagent grade sodium and potassium chlorides used for preparing the samples. (Baker-IVI)
W85-06571

EFFECT OF ORGANIC COLLOIDS ON ASV SIGNALS OF CD, PB AND CU,
Newcastle Univ. (Australia). Dept. of Chemistry.
T. Ugapo, and W. F. Pickering.
Talanta, Vol. 32, No. 2, p 131-138, February, 1985. 4 Fig, 2 Tab, 40 Ref.

Descriptors: *Cadmium, *Lead, *Copper, *Anodic-stripping voltammetry, *Colloids, *Water analysis, Organic compounds, Humic acids, Fulvic acids, Chemical analysis, Pollutant identification.

The effect of both humic and fulvic acids on the anodic-stripping voltammetry (ASV) signals of Cd, Pb and Cu has been reexamined in an attempt to provide additional basic information. The presence of organic acids caused the magnitude of the signal peaks to decrease, owing to their ability to adsorb metal ions, or form complexes. This effect was seen to increase with increasing organic acid: metal ion ratios and pH from 5 to 8. Most of the Cd retained was labile. In the Pb and Cu system less than half of the sorbed metal ion was labile, though a further fraction was displaced in the presence of Chelex 100 resin. The molarity of the medium and the presence of diverse anions in the system both affected the magnitude of the interference. (Baker-IVI)
W85-06572

VIRUSES AND DRINKING WATER,
Thames Water Authority (England). Northern Div.
For primary bibliographic entry see Field 5F.
W85-06577

DETERMINATION OF FENTHION RESIDUES IN SAMPLES OF MARINE BIOTA AND SEA-WATER FROM LABORATORY EXPOSURES AND FIELD APPLICATIONS,
Environmental Research Lab., Gulf Breeze, FL.
E. M. Lores, J. C. Moore, J. Knight, J. Forrester, and J. Clark.
Journal of Chromatographic Science, Vol. 23, No. 3, p 124-127, March, 1985. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Fenthion, *Insecticides, *Seawater, *Marine life, Pesticide residues, Pollutant identification, Water analysis, Organic compounds, Chemical analysis.

Fenthion, an organophosphate insecticide used extensively in the state of Florida, was selected for a field study to examine the applicability of laboratory toxicity data in predicting environmental effects of a pesticide under actual-use conditions. A method for measuring fenthion in samples from the estuarine environment is described. The method was applied to samples from the field applications of fenthion to control salt-marsh mosquitos. The method described is sensitive and efficient for extraction and cleanup of fenthion residues in seawater, marine biota, and sediments. The detection limits for fenthion in seawater and biota are 0.010 microg/liter and 0.010 microg/g, respectively. The cleanup method has been successfully tested on a variety of substrates. It required relatively little time, eliminated co-extractives, and provided adequate sensitivity. Average recovery from tissue is 95%, much better than with previous methods. (Baker-IVI)
W85-06581

TASTES AND ODORS: THE FLAVOR PROFILE METHOD,
Southern California Metropolitan Water District, La Verne.
For primary bibliographic entry see Field 5F.
W85-06582

RECOVERY OF HEXACHLOROCYCLOHEXANE ISOMERS IN FORTIFIED WATER SAMPLES,
Environmental Health Directorate, Ottawa (Ontario).
M. Malaiyandi, E. Junkins, P. L. Bowron, and M. Bowron.
Journal of Environmental Sciences and Health, Vol. A20, No. 2, p 219-237, February, 1985. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Hexachlorocyclohexane, *Chemical analysis, *Isomers, Pesticides, Pollutant identification, Water analysis, Chlorinated hydrocarbons, Statistical analysis.

Recovery studies using water samples fortified with 30-350 ng/L of alpha-, beta-, gamma-, and delta-hexachlorocyclohexane (HCH) isomers using the Kuderna-Danish evaporators and modified Synder column were carried out. These studies consisted of extraction, concentration and analysis by two operators on five different mixed concentrations of the four isomers with five replicates on three different days. The mean % recoveries (+/- standard deviation) of 98.02 +/- 7.27 for the alpha-, 96.61 +/- 4.88 for the beta-, 96.59 +/- 5.72 for the gamma- and 73.89 +/- 11.20 for the delta-isomers were observed. The analysis of variance between concentrations for operator 1 shows that the F ratio is significant for the isomers alpha-, gamma- ($p < 0.05$). However, in the case of operator 2, there were significant differences between concentrations only in the case of the alpha-isomer. It has also been shown that there were significant differences in operator variability for the alpha-, gamma-, and delta-isomers and that operator 2 with minimum experience could obtain consistent recoveries with beta-, gamma- and delta-HCH isomers with greater than 95% confidence. Further, a method has been described for purifying recovered hexane solvent. (Author's abstract)
W85-06601

SOME PROBLEMS IN THE APPLICATION OF THE MPN METHOD FOR THE QUANTITATIVE DETERMINATION OF SALMONELLA (EINIGE PROBLEME BEI DER ANWENDUNG DES MPN-VERFAHRENS ZUR QUANTITATIVEN SALMONELLENBESTIMMUNG),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
M. Nagel, W. Stelzer, and E. Schulze.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 23-35, 1983. 8 Fig, 3 Tab, 9 Ref.

Descriptors: *Most probable number test, *Salmonella, Bacterial analysis, Pathogenic bacteria, Water analysis, Poisson ratio.

So far, the MPN technique has been the method chosen for detecting pathogenic bacteria in waters, since it allows the use of larger volumes. In the evaluation, however, comparatively frequently (10-15%) nontypical codes occur. The validity of the Poisson model is confirmed for pure cultures by extensive laboratory experiments with pure cultures and controlled mixed cultures. In mixed cultures, however, a comparatively large number of atypical codes occur, since obviously a single organism is not sufficient for the formation of a growth-cover on the test tube, so that the true number of organisms may be considerably underestimated. Obviously, the accompanying flora has an inhibiting effect on the salmonella detection. (Author's abstract)
W85-06650

AUTOMATIC DETERMINATION OF CARBON DIOXIDE AND CARBONATE IN WATER ACCORDING TO THE FLOW-STREAM PRINCIPLE (AUTOMATISCHE BESTIMMUNG VON KOHLENDIOXID UND CARBONAT IN WASSER NACH DEM FLOW-STREAM-PRINZIP),
Akademie der Wissenschaften der DDR, Jena. Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie.
G. Proft.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 2, p 235-239, 1983. 1 Fig, 4 Ref.

Descriptors: *Carbon dioxide, *Carbonate, *Water analysis, *Flow-stream principle, Ultrared technology, Extraction, Chemical analysis.

A method is presented for determining carbon dioxide and carbonate in water using ultrared (UR) technology and automatic flow-system analysis. Water samples are placed in receptacles in a storage tank, whence a hose pump drives them via samplers to a gas extractor, where acid can be continuously fed into them. Pressurized air is fed by means of a peristaltic pump through two gas-washing bottles with potash lye in order to absorb carbon dioxide. This almost carbon-dioxide-free mixture is used to blow the carbon-dioxide content of the sample in the gas extractor out into the UR analyzer, where its concentration is determined and registered on a graphic recorder. Reproducibility is strongly dependent on gas-flow constancy, while the correctness of data depends highly on preparation of calibration values. The calibration solution is 208.4 mg KHC03 in 250 ml H20

(C02 free); 1 ml approximately equals 100 micro g C. Both this solution and distilled water required for dilution take up carbon dioxide from the air, so that calibration curves are too high and analysis values too low; fresh calibration solution with carbon-dioxide-free distilled water should be used for each new calibration. For total-carbonate (DIC) analysis, sample receptacles are rinsed with test water and filled with as little turbulence as possible. The high frequency of automatic analysis makes it possible to make multiple determinations from each sample and to obtain a calibration value for each block of samples. Since samples may not be filtered (to avoid carbon-dioxide loss), the determination includes all inorganically dissolved and bound carbonate compounds. For free-carbon-dioxide (FC) analysis, the procedure is similar, but after calibration, the gas extractor is rinsed without acid before sample analysis. Only carbon dioxide that can be blown out by air is measured. The procedure leads to a continuous cycle of shifting of carbonate balance and release of carbon dioxide. (Gish-IVI)
W85-06665

EFFECT OF SOME COAL GASIFICATION AND TAR SAND PROCESS WATERS ON THE VIABILITY OF INDICATOR BACTERIA OF FECAL CONTAMINATION,
Wyoming Univ., Laramie. Div. of Microbiology and Veterinary Medicine.
For primary bibliographic entry see Field 5C.
W85-06725

MODIFICATIONS TO ELECTROLYTIC RESPIROMETER SYSTEMS FOR PRECISE DETERMINATION OF BOD EXERTION KINETICS IN RECEIVING WATERS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 7B.
W85-06734

VALIDATION OF AN AUTOMATED FLUORESCEIN METHOD FOR DETERMINING BROMIDE IN WATER,
Geological Survey, Denver, CO.
M. J. Fishman, L. J. Schroder, L. C. Friedman, C. E. Arozarena, and A. G. Hedley.
Water Research, Vol. 19, No. 4, p 497-501, 1985. 2 Tab, 8 Ref.

Descriptors: *Bromide, *Water analysis, *Ion chromatography, Water quality control, Fluorescein, Chemistry of precipitation, Surface water, Automation.

Surface, atmospheric precipitation and deionized water samples were spiked with micro-g/l concentrations of bromide, and the solutions stored in polyethylene and polytetrafluoroethylene bottles. Bromide was determined periodically for 30 days. Results obtained from the automated fluorescein method are equivalent to results obtained by ion chromatography for the matrices investigated. The estimated variance for the fluorescein method is nearly 70% less than the estimated variance for the ion chromatography method. The fluorescein method is more rapid than the ion chromatography method. In laboratories where a large number of samples are processed, the fluorescein method would be the method of choice. No loss of bromide ion occurred with time in natural water samples stored in polyethylene of PTFE bottles. (Baker-IVI)
W85-06737

SIMULTANEOUS MULTIELEMENT DETERMINATION OF TRACE METALS IN LAKE WATERS BY ICP EMISSION SPECTROMETRY WITH PRECONCENTRATION AND THEIR BACKGROUND LEVELS IN JAPAN,
National Inst. for Environmental Studies, Tsukuba (Japan).
Y. Nojiri, T. Kawai, A. Otsuki, and K. Fuwa.
Water Research, Vol. 19, No. 4, p 503-509, 1985. 1 Fig, 5 Tab, 22 Ref.

Descriptors: *Trace metals, *Lakes, *Spectrometry, *Water analysis, Aluminum, Titanium, Vanadium, Manganese, Iron, Cobalt, Nickle, Copper, Zinc, Cadmium, Lead.

A method combining a preconcentration and determination with inductively coupled plasma emission spectrometry (ICPES) was modified to become suitable for the analysis of trace levels of metals in lake water samples. Preconcentration with evaporation before the separation procedure facilitated obtaining a high concentration factor. Column preparation is not necessary with the use of Sep-Pak C18 disposable plastic column. The adsorption pH is slightly lowered when a high removal rate of magnesium and calcium to avoid severe background shift in ICPES is required. Simultaneous multielement preconcentration and analysis of eleven elements was possible for the lake water sample of the Japanese background level area. This new procedure has the following advantages: few sample manipulations, low analytical blanks and simultaneous multielement preconcentration ability at a single set of treatment conditions. (Baker-IVI)
W85-06738

USE OF THE BIVALVE MYTILUS EDULIS AS A TEST ORGANISM FOR BIOCONCENTRATION STUDIES. 1. DESIGNING A CONTINUOUS-FLOW SYSTEM AND ITS APPLICATION TO SOME ORGANOCHLORINE COMPOUNDS,
National Swedish Environment Protection Board, Stockholm. Special Analytical Lab.
For primary bibliographic entry see Field 5C.
W85-06743

ANIONS IN WATER OF ENERGY GENERATING PLANTS. IMPORTANCE AND ANALYSIS (REVIEW) (ANIONEN IN WASSERN VON ENERGIEERZEUGUNGSANLAGEN - BEDEUTUNG UND ANALYSE (UBERSICHTSBERICHT)),
Vereinigte Elektrizitaetswerke Westfalen A.G., Dortmund (Germany, F.R.).
G. Resch.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 463-469, March, 1985. 14 Fig, 3 Tab, 20 Ref.

Descriptors: *Anions, *Cooling water, *Process water, *Power plants, Clorides, Sulfates, Corrosion, Scaling.

Metallic structural materials are in interaction with the water used in the generation of electricity, steam and remote heat as well as the dissipation of industrial process heat by cooling systems. Durability, availability and efficiency of such operational plants decisively depend on water preparation and treatment for limiting deposits of dissolved materials and corrosion. Analyses of the water that comply with the technical requirements has come to be an indispensable component of all strategies to prevent damage. Anion analysis has a special importance in that regard, as some anions (e.g. chloride and sulfate) promote the corrosion and others lead to sparingly soluble deposits if certain cations are present. (Author's abstract)
W85-06754

ION-CHROMATOGRAPHIC DETERMINATION OF THE ANIONS CL-, NO3- AND SO42- IN RAIN WATER (IONEN-CHROMATOGRAPHISCHE BESTIMMUNG DER ANIONEN CL-, NO3- UND SO42- IN REGENWASSER),
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
F. Wagner, P. Valenta, and H. W. Nurnberg.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 470-476, March, 1985. 10 Fig, 2 Tab, 31 Ref.

Descriptors: *Ion chromatography, *Anions, *Chemical analysis, *Chlorides, *Rain, *Nitrates, *Sulfates, Acid rain, Hydrogen ion concentration, Acids, Chromatography, Sample preservation, Sampling, Water sampling.

Wet deposition of acid onto the vegetation blanket and the surface of fresh waters is of increasing importance for the estimation of environmental damages. Ion-chromatography has been evaluated as a suitable tool for the determination of the most important anions present in rain water. These anions are partly present as anionic components of the totally dissociated strong acids, H2SO4, HNO3, and HCl, responsible for the acidity of the rain. The advantages of the method are sufficient sensitivity, automation, the possibility of a direct simultaneous determination of the three anions and small sample volume. The most frequent sources of error can occur in the sampling step, during sample storage and due to insufficient cleaning of the sampling bottles and the components of the rain water sampler. As a practical application of ion-chromatography the concentrations of the three most important anions were determined in: rain water samples taken in 1983. Sampling was performed at four sampling sites of the Stolberg-Juelich region: Juelich-Hambach, Stolberg-Werth, Stolberg-Gressenich or Stolberg-Muensterbusch und Stolberg-Binsfeldhammer. The anion concentrations varied in the ranges 0.2-7 mg/l Cl(-), 0.5-10 mg/l NO3(-) and 2-20 mg/l SO4(-2) and had a standard deviation up to 15%. (Author's abstract)
W85-06755

DETERMINATION OF CL-, NO3- AND SO42- IN PORE WATERS OF SEDIMENTS,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofftechnologie und Chemie.
For primary bibliographic entry see Field 2K.
W85-06756

ANION CHROMATOGRAPHY OF HYDROGEN CARBONATE, CHLORIDE AND SULPHATE IN MINERAL WATERS WITH COMPARISONS OF METHODS (ANIONEN-CHROMATOGRAPHIE VON HYDROGENCARBONAT, CHLORID UND SULFAT IN MINERALWASSERN MIT METHODENVERGLEICHEN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Lebensmittelchemie.
A. Schweizer, and G. Schwedt.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 480-484, March, 1985. 6 Fig, 4 Tab, 4 Ref.

Descriptors: *Hydrogen carbonate, *Chlorides, *Sulfates, *Ion chromatography, *Chemical analysis, *Mineral water, Chromatography, Carbon dioxide, Anion exchangers, Calcium, Hardness.

An ion-chromatographic HPLC analytical system was utilized for quantitative analysis of hydrogen carbonate, chloride and sulfate in mineral waters. Separation is performed within 8 min on the HPLC anion-exchanger Nucleosil 10-Anion with an aqueous solution of 0.01 mol/l potassium hydrogen phthalate at pH 7.0 as mobile phase. An RI-detector is used for quantitative analysis. The relation of the peak area to the anion concentration was investigated up to 4000 mg/l for hydrogen carbonate, to 4200 mg/l for chloride and to 1500 mg/l for sulfate, respectively, and linearity was proved in these regions. The free carbon dioxide is removed by degassing, and interfering calcium ions are previously precipitated as oxalate. Comparison with reference methods for the determination of single anions shows in each case corresponding results with deviation of less than 5% in most cases. (Author's abstract)
W85-06757

DETERMINATION OF NITRATE IN WATERS BY MEANS OF CHROMOTROPIC ACID (BESTIMMUNG VON NITRAT IN GEWASSERN MIT HILFE VON CHROMOTROPSAURE),
Gesamthochschule Wuppertal (Germany, F.R.). Fachbereich 9 - Analytische Chemie.
P. Bachhausen, N. Buchholz, and H. Hartkamp.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 490-493, March, 1985. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Nitrates, *Water analysis, *Spectrophotometry, Nitrites, Chloride, Iron, Interference.

The growing contamination of natural waters with nitrate requires constant monitoring of nitrate levels. A spectrophotometric method is described for the determination of nitrate in waters with the aid of chromotropic acid. The method differs from the procedures reported so far in the large work-range, the small sample required, the high long-term stability of the reagent solution and in the small amount of work. The interferences from nitrite, chloride and iron(III) in the chromotropic acid method were investigated. Chloride concentrations up to 200 mg/l and nitrite concentrations up to 10 mg/l did not substantially interfere with this method. Iron(III) concentrations up to 10 mg/l did not interfere with nitrate measurement. (Moore-IVI)
W85-06758

SIMULTANEOUS DETERMINATION OF CL-, BR- AND I- IN WATER SAMPLES BY ISOTOPE DILUTION MASS SPECTROMETRY (GLEICHZEITIGE BESTIMMUNG VON CL-, BR- UND I- IN WASSERN DURCH MASSENSPEKTROMETRISCHE ISOTOPENVERDUNNUNGSANALYSE),
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
K. G. Heumann, and H. Seewald.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 493-497, March, 1985. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Chemical analysis, *Chlorides, *Bromides, *Iodides, *Isotope dilution mass spectrometry, *Mass spectrometry, Spectrometry, Ion chromatography, Chlorine, Bromine, Iodine, Halogens.

An analytical procedure was developed which allows the trace determination of Cl(-), Br(-) and I(-) in different water samples by isotope dilution mass spectrometry within a single reprocessing of the sample. This definitive method has the advantage that the analytical results are relatively accurate and is thus especially suitable as a calibration method. The method was utilized for analysis of water samples from a drinking water reservoir, different springs, river and a mineral water. The relative standard deviation for the chloride determination in the lower ppm-range is 0.2-1.6%, for the bromide and iodide analysis in the lower ppb-range it is 0.5-5%. The detection limits of this method - which could be improved by a more precise isotope ratio measurement - are 13 ppb for Cl(-), 0.4 ppb for Br(-) and 0.1 ppb for I(-). An analytical comparison for the chloride determination showed good agreement between the mass spectrometric method and ion chromatography. An analysis procedure was presented which allows the determination of the inorganic iodine species iodide and iodate in water samples by isotope dilution mass spectrometry. (Author's abstract)
W85-06759

DETERMINATION OF TRACE ELEMENTS IN RIVER WATER BY MEANS OF VOLTAMMETRY (BESTIMMUNG VON SPURENELEMENTEN IN FLUSSWASSER MIT HILFE DER VOLTAMMETRIE),
Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Maschinenbau.
M. Weidenauer, and K. H. Lieser.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 550-555, March, 1985. 2 Fig, 6 Tab, 22 Ref.

Descriptors: *Trace elements, *Chemical analysis, *River water, *Voltammetry, *Detection limits, Zinc, Cadmium, Lead, Copper, Nickel, Cobalt, Thallium, Manganese, Bismuth, Selenium, Ultraviolet radiation, Chemical reactions, Metals, Trace metals.

The determination of trace elements in river water by voltammetry is disturbed by the presence of organic substances. The influence of these substances can be eliminated by oxidative UV-photolysis. After UV irradiation the following elements were determined in Rhine water by voltammetry: Zn, Cd, Pb, Cu, Ni, Co, Tl and, with reservations, Mn. The concentrations of Bi and Se were below the detection limits. The detection limits in river water for the elements mentioned were determined and found to be between 0.1 and 1 micro-g/l. Comparative determinations by AAS (graphite tube) showed good agreement for Cu, Zn and Mn, whereas the concentrations of the other elements were below the detection limits of AAS. The complexing capacity of Rhine water for Zn, Cd, Pb and Cu was determined by voltammetric titration. It decreased in the order Cu > Zn > Pb > Cd and was between 5.0 and 0.7 micro-g/l. (Author's abstract)
W85-06760

DETERMINATION OF DISSOLVED HEXAVALENT CHROMIUM IN RIVER WATER, SEA WATER AND WASTE WATER,
Rijks-Kwaliteitsinstituut voor Land-en Tuinbouwprodukten, Wageningen (Netherlands).
G. Vos.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 320, No. 5, p 556-561, March, 1985. 3 Fig, 4 Tab, 14 Ref.

Descriptors: *Chromium, *Wastewater analysis, *Seawater, *Water analysis, Coprecipitation, Atomic absorption spectrometry, Pollutant identification, Sulfates, Chlorides.

A lead sulfate coprecipitation procedure was developed for determination of chromium (VI) in water. The procedure was modified from the Martin and Riley procedure, and had an appreciably lower limit of detection. Chromium (VI) was quantitatively coprecipitated with lead sulfate from weakly acidic (pH 3.5) sample solutions. Determination was made by graphite furnace atomic absorption spectroscopy at 357.9 nanometer. In a series of 226 determinations with samples of laboratory mixtures, waste water effluents, river waters, and sea water, the detection limit was 0.3 microgram/liter at a 95% confidence level. Relatively high concentrations of chromium (III) did not interfere with the determination of hexavalent chromium, but high chloride (> 6 g/l) or sulfate (> 800 mg/l) resulted in a significant reduction in chromium (VI) recoveries. The sulfate interference was reduced, but not eliminated, in the presence of high chloride concentrations, whereas chloride interferences were eliminated by the presence of sufficient sulfate in the original sample. Chromium (VI) was recovered quantitatively from water and effluents, but recovery from seawater was incomplete (83%) as a result of sulfate interference during coprecipitation. Effects of centrifuging speed, the procedure for withdrawing of supernatant, and changes of chromium content and speciation during storage are discussed. (Rochester-IVI)
W85-06761

SIMULTANEOUS GLC DETERMINATION OF FENITROTHION, AMINOCARB AND THEIR CORRESPONDING HYDROLYSIS PRODUCTS IN WATER,
Moncton Univ. (New Brunswick). Dept. of Chemistry.
A. Cassista, and V. N. Mallet.
Chromatographia, Vol. 18, No. 6, p 305-308, June, 1984. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Gas-liquid chromatography, *Fenitrothion, *Aminocarb, Hydrolysis, Phenols, Insecticides, Thermionic detectors, Pesticide residues.

A Tracor Model 560 gas-liquid chromatograph (GLC) equipped with a thermionic nitrogen-phosphorous detector was used for simultaneous detection of fenitrothion, aminocarb, and their hydrolysis products (3-methyl-4-nitrophenol and 4-dimethylamino-3-methylphenol, respectively) in natural water. In a series of three experiments in which environmental water was spiked with known amounts of fenitrothion, aminocarb, and their corresponding phenols in the same sample, aminocarb and fenitrothion were recovered at 97% and 99%, respectively, and the corresponding phenols were recovered at 100%. Chromatograms exhibited some interfering peaks, and resolution was not ideal, but detection and quantitation of aminocarb and the two phenols at 0.1 ppb was possible, and the limit of detection of fenitrothion was at least 0.01 ppb. Comparison of the present method with high performance liquid chromotography showed very good agreement for detection of the two insecticides and their phenols in environmental water as part of a monitoring program. (Rochester-IVI)
W85-06762

DETERMINATION OF CHLOROPHENOLS IN WASTE WATER USING C18 REVERSE-PHASE ENRICHMENT PRIOR TO HIGH RESOLUTION GASCHROMATOGRAPHY - MASS SPECTROMETRY,
State Chemical Supervision Service, Soeborg (Denmark).
P. G. Nielsen.
Chromatographia, Vol. 18, No. 6, p 323-325, June, 1984. 1 Fig, 5 Tab, 7 Ref.

Descriptors: *Chlorophenols, *Wastewater analysis, *Gas chromatography, *Mass spectrometry, Chlorocresols, Herbicides, Halogenated hydrocarbons, Phenoxy compounds, Industrial wastes.

Reverse-phase enrichment employing Sep-pak C18 cartridges, followed by gas chromatography using fused-silica capillary columns in combination with mass spectrometry was tested and subsequently employed in studies of municipal waste water samples containing chlorophenols and chlorocresols. The effects of the presence of a mixture of substances on the results were assessed by recovery studies involving eight chlorophenols at levels of 5-20 ppb added to pure water, water samples containing phenoxy herbicides MCPA, dichloroprop, and mecoprop at levels of 400 ppb, and waste water samples from a municipal purifying plant receiving phenoxy herbicides and chlorophenols from a chemical plant. With a 100 ml sample, monochlorinated phenols were recovered at 30-50%; higher substituted phenols were recovered at near quantitative yield. For higher halogenated phenols recovery was quantitative even with a 1,000 ml sample. Phenol itself was recovered at only 5-8% from a 100 ml sample. Twenty-five waste water samples were obtained regularly from a municipal treatment plant and analyzed. The identity of phenols was unambigous from the ion chromatogram and retention time. The peak shape of underivatized phenols was extremely sensitive to the presence of heavy contamination with high molecular mass substances, which resulted in rapid decrease in column efficiency. With capillary columns with crosslinked stationary phases, performance could be restored easily by washing the stationary film with organic solvent. (Rochester-IVI)
W85-06763

SEPARATION OF MOLYBDOHETEROPOLY ACIDS OF PHOSPHORUS, ARSENIC, SILICON AND GERMANIUM AS ION-ASSOCIATES BY HPLC. APPLICATION TO QUANTITATIVE DETERMINATION IN WATER,
Tieraerztliche Hochschule Hannover (Germany, F.R.). Chemisches Inst.
M. Braungart, and H. Russel.
Chromatographia, Vol. 19, p 185-187, 1984. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *High-performance liquid chromatography, *Phosphorus, *Arsenic, *Silicon, *Germanium, Water analysis, Chromatography, Molybdoheteropoly acids.

A high-performance liquid chromatography (HPLC) method was perfected for detection of phosphorus, arsenic, silicon, and germanium as molybdoheteropoly acids (HPAs) stabilized by amine. A Knauer Model 87.00 UV-detector (310 nanometer) was employed; best retention and separation were obtained with NUCLEOSIL CN as the stationary phase. In a 20 microliter sample containing 200 ng each of HPA ion associates, As-HPA associate, P-HPA associate, alpha-Si-HPA associates, Ge-HPA associate, isopoly compound, and beta-Si-HPA were clearly separated. Dissolved inorganic phosphorus in water could be determined in the presence of silica at levels limited only by the level of laboratory contamination. HPLC of molybdoheteropoly compounds allows study of the structure and constitution of HPAs, especially inversion rates and mechanisms. The technique is useful for

multielement determinations of P, As, Si, and Ge in natural waters, and it provides information on speciation of the various compounds. (Rochester-IVI)
W85-06764

TOXINS FROM FRESHWATER CYANOBACTERIA,
Wright State Univ., Dayton, OH. Dept. of Biological Sciences.
W. W. Carmichael, and K. A. Mahmood.
ACS Symposium Series, Vol. 262, p 377-389, 1984. 5 Fig, 1 Tab, 39 Ref.

Descriptors: *Toxins, *Cyanophyta, Cyanobacteria, Eutrophication, Water pollution, Anatoxins, Alkaloids, Peptides, Aphantoxins.

Toxins are produced by several planktonic bloom forming genera of freshwater cyanobacteria. The main genera responsible for freshwater toxic blooms are Microcystic, Anabaena, Apanixomenon and Oscillatoria. Cyanobacterial toxins (both marine and freshwater) are functionally and chemically a diverse group of secondary chemicals. Toxins include: anatoxins, alkaloids and peptides; the peptide microcystin and related peptides; aphantoxins, compounds with properties similar to some paralytic shellfish poisons (PSP). Of particular importance is the production of toxins which appear to be identical with saxitoxin and neosaxitoxin. Since they are the primary toxins involved in cases of PSP, these aphantoxins could be a source of PSP standards. The study of their production by Aphanizomenon can provide information on the biosynthesis of PSP's. The cyanobacteria toxins have not received extensive attention since they have fewer vectors by which they come in contact with humans. As freshwater supplies become more eutrophicated and as cyanobacteria are increasingly used as a source of single cell protein, toxic cyanobacteria will have increased importance. The study of these cyanobacterial toxins can contribute to a better understanding of seafood poisons. (Baker-IVI)
W85-06779

DISTRIBUTION OF OLIGOCHAETES IN LAKE MICHIGAN AND COMMENTS ON THEIR USE AS INDICES OF POLLUTION,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
D. D. Lauritsen, S. C. Mozley, and D. S. White.
Journal of Great Lakes Research, Vol. 11, No. 1, p 67-76, 1985. 7 Fig, 2 Tab, 33 Ref. EPA grant R-805333010.

Descriptors: *Lake Michigan, *Great Lakes, *Oligochaetes, *Tubificids, *Sediments, *Bioindicators, Annelids, Benthos, Infauna, Eutrophication, Organic matter, Water pollution effects.

Benthic samples were taken from 286 stations covering all areas of Lake Michigan in 1975 as part of a sedimentological survey of the Great Lakes. From these samples a total of twenty-seven oligochaete species were identified. Stylodrilus heringianus was the most abundant species in the lake and densities were inversely related to organic content of the sediments. Tubificids exhibited localized concentrations in Green Bay and in the northern and southern basins. Comparison of several methods using oligochaete data to assess water quality showed similar patterns, indicating that Southern Green Bay and parts of the southern and northern basins of the lake are organically enriched environments. With the exception of the northern basin, which had not previously been surveyed, these conclusions are consistent with earlier regional oligochaete surveys of the lake. The northern basin of Lake Michigan warrants further study to generate and test hypotheses concerning tubificid species distributions observed there. (Author's abstract)
W85-06866

USE OF VOLATILE CHLOROORGANICS AS A MEASURE OF THE REHABILITATION OF THE ST. LOUIS RIVER AND BAY,
Minnesota Univ., Minneapolis. Dept. of Chemistry.
W. J. Doucette, P. K. Johnson, and R. Caple.
Journal of Great Lakes Research, Vol. 11, No. 1, p 77-81, 1985. 4 Fig, 14 Ref. NOAA Office of Sea Grant Program grant NA79AA-D-00139.

Descriptors: *Pulp and paper industry, *Fate of pollutants, *Chlorinated hydrocarbons, *St. Louis River, *Lake Superior, *Cloquet, *Minnesota, *Wastewater treatment, Industrial wastewater, Indicators, Chloroform, Bleaching wastes.

One of the major sources of chloroorganic discharge into the St. Louis River system had been the Potlatch Paper Mill located at Cloquet, Minnesota, about 33 km upstream from Lake Superior. The Potlatch Paper Mill effluent receives primary treatment at the mill and is now treated at the new (winter 1978-79 startup) Western Lake Superior Sanitary District (WLSSSD) advanced secondary sewage treatment plant rather than being discharged directly into the St. Louis River. The effect of diverting the pulp mill effluent to the treatment plant, located 33 km downstream, was examined using a 'chloroform monitoring technique.' Chloroform, formed during the bleaching of pulp, was used as a tracer substance to follow the movement of the chloroorganic effluent plume originating from the pulp mill. The treatment plant was shown to be only partially effective in removing chloroorganics, indicating that the point source of chloroorganic discharge into the St. Louis River system has only been relocated. In addition, the WLSSD plant itself uses large quantities of chlorine in its disinfection process and no doubt causes the production of additional chloroorganics, although the main source of chloroorganics in the WLSSD effluent is the Potlatch Paper Mill. (Collier-IVI)
W85-06867

MINERAL CONTENT OF CANADA GOOSE EGGS AND IMPLICATIONS FOR ENVIRONMENTAL SURVEILLANCE ALONG THE COLUMBIA RIVER,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
W. H. Rickard, and R. E. Fitzner.
Northwest Science, Vol. 59, No. 1, p 28-32, 1985. 1 Fig, 1 Tab, 16 Ref. DOE contract DE-AC06-76RLO 1830.

Descriptors: *Minerals, *Eggs, *Geese, *Columbia River, *Washington, Water pollution effects, Phosphorus, Sulfur, Sodium, Calcium, Potassium, Magnesium, Zinc, Selenium, Lead, Nickel, Barium, Strontium, Manganese, Iron, Aluminum.

Nesting geese provide a natural population that can be used as an indicator of biologically available metal contamination in their foraging environment. Eggs are particularly useful because killing of birds is not required and eggs are available year after year. Eggs were taken from deserted goose nests on islands in the Hanford Reach of the Columbia River, Washington, one month before the eruption of Mount St Helens. Phosphorus, sulfur and sodium were the most abundant elements in goose eggs followed by calcium, potassium, and magnesium. Calcium concentrations were higher in eggs from certain clutches with values ranging from 4400-6600 ppm as compared to values ranging from 2200 to 4000 for upstream islands. Eggs collected from island 17 had about the same levels of trace element Cu, Zn, Mn, and Se as compared to eggs taken from islands 11, 12, 15, and 19. Eggs from two of three clutches from island 17 had enhanced levels of Al, Ni, and Cr but Pb levels were only marginally elevated. Island 17 is located within 1 km of a uranium fuel fabrication facility located on the western bank of the river, and island 19 is located several km downstream. (Baker-IVI)
W85-06873

FACTORS AFFECTING TRACE METAL ACCUMULATION BY ESTUARINE OYSTER CRASSOSTREA VIRGINICA,
District of Columbia Univ., Washington. Dept. of Biology.
H. L. Phelps, D. A. Wright, and J. A. Mihursky.
Marine Ecology, Vol. 22, No. 2, p 187-197, 1985. 9 Fig, 5 Tab, 41 Ref. NASA grant NGR 09-050-019.

Descriptors: *Trace metals, *Estuarine environment, *Oysters, *Bioaccumulation, *Water pollution effects, Copper, Zinc, Cadmium, Silver, Mollusks, Salinity, Animal physiology, Bioindicators, Indicators.

Copper, zinc, cadmium and silver analyses were made of groups of ca 34 individual oysters taken from 13 oyster bars in the mid-Chesapeake Bay region on the east coast of the United States. Data are described for the years 1978, 1979 and 1981. Sampling stations were chosen to represent high and low salinity regimens as well as sites of potentially differing metal input. Metal concentrations were determined on a wet-weight basis and were found to be largely negatively correlated with body weight and with salinity. Data were entered in a multiple regression program which included body weight and salinity as independent variables, and regression equations were used to normalize the metal concentrations. Data indicated localized copper concentration in oysters close to 2 electricity generating stations, although at 1 of these sites the high values could be explained in terms of the body weight/salinity model. High metal concentrations were also indicated at an oyster bar having stunted animals. Results indicated that the use of oysters to map trace metal input to an estuary can be complicated by extraneous factors such as salinity, but that useful information may still be obtained after normalization to size and salinity. Year-to-year comparison between these data and earlier data indicate that correction for salinity may have to be reset from year to year. (Author's abstract)
W85-06878

DETERMINATION OF HALOGENATED CHEMICALS IN WATER BY THE PURGE AND TRAP METHOD, METHOD 502.1,
Environmental Protection Agency, Environmental Monitoring and Support Lab., Cincinnati, OH.
T. A. Bellar, and J. J. Lichtenberg.
EPA Report No. 600/4-81-059, 1981. 50 p, 7 Fig, 4 Tab, 3 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Halogenated compounds, *Chlorinated hydrocarbons, *Chemical analysis, Organic compounds, Trihalomethanes, Gas chromatography, Chromatography, Drinking water.

A method for determining organohalides in water uses an extraction/concentration technique to enhance the quantities of analyte injected into the gas chromatograph by a factor of 1000 compared with direct injection gas chromatography. An inert gas is bubbled through the sample. Those organohalides and other organic constituents which boil at less than 200 degrees C, are removed from the aqueous phase and trapped in a short column containing a sorbant combination. After a predetermined time, the trapped components are thermally desorbed, backflushed onto the head of a gas chromatograph and separated under programmed conditions. Measurement is done with a halogen-specific detector. The method is useful for determination of carbon tetrachloride, 1,2-dichloroethane, tetrachloroethylene, 1,1,1-trichloroethane, trichloroethylene, vinyl chloride, and 44 additional halogenated compounds listed in a table. The method, useful for detection and measurement of multicomponent mixtures spiked into carbon filtered finished water and raw source water at concentrations of 0.20-0.40 micrograms per liter, has detection limits of $<$ 0.01 micrograms per liter. The compounds listed in the table can be accurately measured over a concentration range of 0.10-5.0 micrograms per liter. Individual organohalides can be determined at concentrations up to 1500 micrograms per liter.
W85-06915

DETERMINATION OF CHEMICAL THRESHOLD CONCENTRATIONS USING 2,4-D TO CONTROL SELECTED AQUATIC MACROPHYTES: A PILOT STUDY TO EVALUATE A LABORATORY SYSTEM,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 4A.
W85-06917

HANDBOOK FOR SAMPLING AND SAMPLE PRESERVATION OF WATER AND WASTEWATER.
Environmental Monitoring and Support Lab.-Cincinnati, OH.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124503. EPA-600/4-82-029, September 1982. Edward L. Berg, editor. 402 p, 122 Fig, 64 Tab, 219 Ref, 2 Append.

Descriptors: *Pollutant identification, *Water analysis, *Wastewater analysis, *Sampling, Water sampling, Biological samples, Bottom sampling, Sample preparation, Sample preservation, Microbiology, Statistical analysis, Flow measurement, Quality control, Industrial wastewater, Municipal wastewater, Agricultural wastes, Surface water, Aquatic life, Bottom sediments, Sediments, Groundwater, Drinking water, Sludge, Suspended solids, Organic compounds, Trace levels, Radioactive wastes, Bacterial analysis, Chemical analysis.

Guidelines for sample collection and preservation were derived from a literature review and a survey of field practices. This handbook covers general considerations for a sampling program, flow measurments (in closed conduits, from pipes, in open channels, etc.), statistics, and sampling of the following: municipal wastewater, industrial wastewater, agricultural discharges, surface waters, aquatic organisms, bottom sediments, groundwater, drinking water, sludges, suspended solids, radioactive materials, trace organics, and microbiological samples. Sample control and chain of custody are discussed. Quality assurance programs and sample preservation are also included. This material does not supersede procedures already specified by enforcement, compliance monitoring, or program offices of the EPA.
W85-06919

CALCIUM OXIDE AND HYDROXIDE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario). Environmental Protection Programs Directorate.
EN-48-10/3-1984E, March 1984. 57 p, 9 Fig, 4 Tab, 118 Ref.

Descriptors: *Pollutant identification, *Water pollution effects, *Toxicity, *Calcium hydroxide, *Water pollution prevention, *Calcium oxide, *Lime, *Cleanup operations, Alkalinity, Fish, Ecological effects, Environmental effects, Aquatic life.

Calcium oxide (CaO) when spilled is corrosive and harmful to humans by all exposure routes at elevated levels and harmful to aquatic life if pH is raised significantly. The aquatic toxicity of CaO is a function of alkalinity. CaO has shown no food chain concentration or bioaccumulation toxicity potential. CaO spills should be confined as soon as possible and be kept from entering sewers or watercourses. If it enters soil, CaO should be removed by manual or mechanical means. If it enters water, damming, water diversion and natural barriers should be used to contain CaO. Calcium hydroxide (Ca(OH)2) can decompose to produce CaO. It is mildly corrosive to humans by all routes and harmful to aquatic life. The aquatic toxicity of Ca(OH)2 is a function of alkalinity and it has shown no food chain concentration or bioaccumulation toxicity potential. Remedial actions to Ca(OH)2 spills are similar to those for CaO spills. CaO is detected quantitatively in water by atomic absorption spectroscopy or qualitatively by a flame test.
W85-06935

MICROWAVE SYSTEMS FOR DETECTING OIL SLICKS IN ICE-INFESTED WATERS: PHASE 1, LITERATURE REVIEW AND FEASIBILITY STUDY.
Memorial Univ. of Newfoundland, St. John's. Centre for Cold Ocean Resources Engineering.
EPS 3-EC-81-3, September 1981. Department of the Environment, Ottawa (Ontario). 356 p, 4 Fig, 16 Ref, 6 Append.

Descriptors: *Oil spills, *Pollutant identification, *Oil slicks, *Microwaves, *Radar, *Oily water, *Sea ice, *Remote sensing, Ice cover, Arctic zone, Radiation, Aerial photography, Sensors, Spectrophotometry.

The feasibility of using microwave techniques for detecting oil pollution in ice environments was studied. Ku- or X-band active measurements and L-band measurements proved suitable for detecting oil when it is present on and in the top surface of the ice. Both VV and HH polarizations were also successful, and cross-polarization provided additional useful data. Active and passive systems operating in the frequency range of 100-300 MHz may be able to detect oil when it is present under ice or contained within the lower regions of sea ice. However, only a qualitative assessment of a limited nature can be made on the performance of active and passive microwave systems in detecting oil slicks in the ice environment due to the limited data available on microwave emission and scattering from sea ice, oil on water, and the ocean. The presence of oil in the ice environment may often be detected through subtle changes in texture and tone induced by oil such as increased metling in comparison with oil free areas. Possible radar data processing and analysis methods are considered. It is suggested that theoretical and laboratory studies, as well as field experiments under controlled conditions, are likely to produce quantitative data on the microwave emission and scattering from oil in the ice environment.
W85-06942

PARASITES AND THE LAND APPLICATIONS OF SEWAGE SLUDGE,
Ontario Ministry of the Environment, Toronto. Pollution Control Branch.
For primary bibliographic entry see Field 5D.
W85-06978

APPLICATION OF 'HEAD-SPACE' ANALYSIS TO DETERMINING READILY VOLATILE CHLORINATED HYDROCARBONS IN SURFACE WATERS (ANWENDUNG DES 'HEAD-SPACE' - VERFAHRENS AUF DIE BESTIMMUNG LEICHTFLUCHTIGER CHLORIERTER KOHLENWASSERSTOFFE IN OBERFLACHENGEWASSERN),
Bundesanstalt fuer Gewaesserkunde, Coblenz (Germany, F.R.).
H. Hellmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 2, p 92-98, April, 1985. 9 Fig, 7 Tab, 9 Ref.

Descriptors: *Head-space analysis, *Volatile organics, *Chlorinated hydrocarbons, *Chemical analysis, Water analysis, Trichloroethane, Trichloromethane, Perchloroethane, Trichloroethane, Ionization, Fluid extraction.

Head-space analysis is especially applicable for volatile substances that pass at higher water sample temperatures into the gas phase; there is a temperature dependent equilibrium between the concentration in water and in the gas phase. Using head-space analysis in conjunction with an automatic sampling valve, different chlorinated hydrocarbons of high and higher volatility can be determined at a minimum expenditure of work and time. With separation of unwanted pollutants not required the analytical procedure is simplified. Detection of volatiles is carried out by ionization or electron absorption detectors. Reproducibility, influence of variable device parameters, and detection limits were systematically investigated; surface water samples including rain and spring water were used. Compared with fluid extraction with pentane, the precision of the results and detection limits are favorable. Compounds such as trichloromethane, tetrachloromethane, trichloroethane, and perchloroethane can be determined very easily in rain, spring, and river water. (Collier-IVI)
W85-07027

EVALUATION OF A COMMUNITY-BASED INDEX USING BENTHIC INDICATOR-ORGANISMS FOR CLASSIFYING STREAM QUALITY,
Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
D. J. Schaeffer, W. H. Ettinger, W. J. Tucker, and H. W. Kerster.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 167-171, February, 1985. 3 Tab, 16 Ref.

Descriptors: *Streams, *Water quality control, *Bioindicators, *Benthos, Benthic environment, Indexes, Statistical analysis.

The question of whether benthic classification of stream quality accurately represents the chemical classification of stream quality is addressed. More effective ways of using benthic data to assess water quality are not considered. The classification system as considered gives consistent results. Organisms specified as intolerant are generally not found in association with organisms in other categories. The demonstration of independence of this class of organisms from all other classes of organisms is critical, because it is this class that determines the index value. The results strongly suggest that organisms sharing similar habitat preferences have the same specification. Therefore, the index value calculated as the percentage of intolerant species should usefully discriminate between various water quality classes. This implies that if Schiffman's original validation study were thorough, classifications made today using his system will be correct most of the time. Although the system is robust to incorrect specification of organisms, it could be improved by omission of those species that are not discriminating and consequently add little but noise to classification. (Baker-IVI)
W85-07046

BIOMONITORING FOR TOXICS CONTROL IN NPDES PERMITTING,
Oak Ridge National Lab., TN. Energy Div.
R. D. Roop, and C. T. Hunsaker.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 271-277, April, 1985. 2 Fig, 2 Tab, 24 Ref.

Descriptors: *Water quality control, *Biomonitoring, *Permits, Toxicity, Monitoring, Species variability, Testing.

Major topics discussed at the WPCF Ecology Committee sponsored workshop entitled Biomonitoring For NPDES Compliance are reviewed, including EPA's proposed approach to biomonitoring and the important issues that surround the use of biomonitoring techniques. Specific topics discussed include an overview of biomonitoring, the rationale for using biomonitoring in permitting, EPA's assessment methodology with emphasis on initial scoping and effluent characterization plus exposure assessment and wasteload allocation with permitting, issues in the water quality based toxics control process such as correlation of effluent toxicity measurements to actual instream impact and the variabiity within toxicity test methods. Also considered are effluent variability, exposure variability and species variability, the acute to chronic ratio and behavior of toxicants after discharge. (Baker-IVI)
W85-07048

APPLICATION OF REVERSED-PHASE LIQUID CHROMATOGRAPHY TO DISSOLVED ORGANIC MATTER IN ESTUARINE SEAWATER,
Hiroshima Univ. (Japan). Faculty of Integrated Arts and Sciences.
K. Hayase, K. Shitashima, and H. Tsubota.
Journal of Chromatography, Vol. 322, No. 2, p 358-362, April, 1985. 2 Fig, 14 Ref. Japanese Ministry of Education, Science and Culture grant 57490010.

Descriptors: *Reversed phase liquid chromatography, *Organic matter, *Dissolved solids, *Estuaries, Water analysis, Water quality control, Monitoring, Seawater, Chromatography.

Preliminary results on the application of reversed phase liquid chromatography with double detectors (fluorescence and absorption) to the analysis of dissolved organic matter (DOM) in estuarine

seawater are reported. From seawater, the DOM with elution volumes in the range between 2.70 and 4.28 could be isolated. The three fractions of the DOM extracted from the seawater sample were less hydrophilic than the sedimentary fulvic acid. Fractions with elution volumes larger than the fraction 2-Z and smaller than the fraction X were not observed in the chromatograms. It is not known whether such fractions do not exist in seawater or that they cannot be extracted into chloroform. Further study should be concerned with developing methods for concentrating DOM to a maximum degree. Here, the hydrophilic-hydrophobic balance and aromatic character of the DOM in seawater were actually represented on the chromatograms. The application of reversed phase liquid chromatography with double detectors appeared to be effective in the characterization of DOM in seawater. (Baker-IVI)
W85-07065

INFLUENCE OF THE TIME OF ACIDIFICATION AFTER SAMPLE COLLECTION ON THE PRESERVATION OF DRINKING WATER FOR LEAD DETERMINATION,
Health Effects Research Lab., Cincinnati, OH.
R. G. Miller, J. U. Doerger, F. C. Kopfler, J. Stober, and P. Roberson.
Analytical Chemistry, Vol. 57, No. 6, p 1020-1023, May, 1985. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Acidification, *Sample preservation, *Drinking water, *Lead, Water analysis, Sample preparation, Water sampling.

It has been suggested that to obtain accurate data for trace metal analysis of drinking water, immediate acidification at the time of collection is necessary. However, because of problems encountered by EPA in field operations and epidemiology studies, further investigation into this requirement was pursued. Drinking water samples containing known concentrations of lead were acidified at different time intervals after collection. The water samples were then stored at room temperature for varying time intervals before being analyzed for lead. For each time period there were seven samples with three aliquots from each taken for analysis in duplicate by flameless atomic absorption spectrophotometry (AAS). All acidified samples that were spiked with lead gave a higher lead value than the unacidified samples having comparable lead concentrations. Lead recovery varied among the time periods studied: however, the results indicated that acidification of water samples after collection could be delayed up to 14 days without any adverse effect on lead concentration data. This would allow acidification after samples are received in the laboratory and thus facilitate field studies. (Author's abstract)
W85-07088

TOXICITY OF NITRITE AND ITS DETERMINATION IN POLLUTED WATERS USING A NEW REAGENT,
Ravishankar Univ., Raipur (India). Dept. of Chemistry.
A. K. Baveja, and V. K. Gupta.
Asian Environment, Vol. 6, No. 4, p 4-8, 1984. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Water analysis, *Nitrites, Diazonium salts, Chemical reactions, Water quality control, Potable water, Pollutant identification.

A new method is described for the determination of nitrite in potable and polluted water, based on the reaction of nitrite with p-nitroaniline to form diazonium salt and its subsequent coupling with N-(1-naphthyl) ethylene diamine dihydrochloride in acidic medium. The purple color dye obeys Beer's law in the range 0.08 to 0.48 ppm in the aqueous phase and gamma-max = 545 nm. The molar absorptivity and Sandell's sensitivity being 78200 l/mole/cm and 0.00058 micro-g/sq cm, respectively. The optimum reaction conditions and other analytical parameters have been studied. The proposed method is simple, rapid and far more sensitive than the standard method. The solvent extraction of the dye in iso-amyl alcohol is advantageous because it enhances the sensitivity of the method although other parameters remain the same. In aqueous media, the range of determination of nitrite is 0.08 ppm to 0.48 ppm in a 25 ml sample, whereas in the extraction procedure, the range of determination of nitrite is considerably lowered and it is possible to determine 0.02 to 0.12 ppm of nitrite in a 100 ml sample. A large number of common ions normally present in polluted waters cause no interference. (Baker-IVI)
W85-07106

WATER ANALYSIS,
Geological Survey, Denver, CO.
J. R. Garbarino, T. R. Steinheimer, and H. E. Taylor.
Analytical Chemistry, Vol. 57, No. 5, p 46R-88R, 1985. 874 Ref.

Descriptors: *Water analysis, *Water chemistry, *Chemical analysis, Inorganic compounds, Organic compounds, Water quality control, Sampling, Metals, Pesticides, Detergents.

Recent research in the areas of inorganic and organic analytical chemistry of water is reviewed. In the area of inorganic analysis topics covered include alkali and alkaline-earth metals (barium, beryllium, calcium, cesium, and magnesium), transition metals (scandium, titanium, vanadium, chromium, manganese, iron, nickel, copper, multimetal analysis, molybdenum, ruthenium, palladium, silver, osmium, and gold), group 12 metals (zinc, cadmium, and mercury), group 13 elements (aluminum, and thalium), group 14 elements (lead, and tin), group 15 elements (bismuth), metalloids (boron, germanium, arsenic, antimony, and tellurium), nonmetals (carbon, nitrogen and phosphorus, selenium, and sulfur), radionuclides (radium and thorium), and actinide elements. Multielement techniques considered include electrochemistry, spectrophotometry, atomic absorption spectrometry, atomic emission spectrometry, mass spectrometry, x-ray fluorescence spectrometry, neutron activation analysis, preconcentration and separation. Also considered are anions and, in particular, nitrogen anions, phosphorus anions and halides. Gases discussed include ammonia, chlorine, ozone, oxygen, and carbon dioxide. Miscellaneous inorganic analyses topics briefly considered include alkalinity-acidity, pH, hardness and sampling techniques. Under organic analysis specific attention is devoted to gas chromatography, gas chromatography/mass spectrometry, liquid chromatography and high-performance liquid chromatography, extraction and concentration techniques, photometry and spectrophotometry. Specific methods for pesticides and detergents are noted. Other topics included are total elemental analysis and oxygen demand, and sampling methods. (Baker-IVI)
W85-07112

COLIPHAGES AS INDICATORS OF ENTERIC VIRUSES IN ACTIVATED SLUDGE,
Texas Univ. at Austin. Dept. of Civil Engineering.
S. W. Funderburg, and C. A. Sorber.
Water Research, Vol. 19, No. 5, p 547-555, 1985. 6 Tab, 13 Ref.

Descriptors: *Sludge, *Viruses, *Bioindicators, *Coliphages, Indicators, Sludge treatment, Phages, Coliforms, Activated sludge process.

Indigenous Escherichia coli bacteriophages in sewage are composed of a heterogeneous population of large and small viruses. These coliphages plaque in different proportions on different E. coli strains. Total indigenous coliphages and fecal coliforms are not suitable indicators of enteric viruses in either primary or secondary activated sludge effluent. Coliphage forming plaques greater than 3 mm in diameter may serve as indicators of the effectiveness of enterovirus removal during activated sludge treatment. The volatile suspended solids concentration in secondary effluent may also be a means by which the effectiveness of activated sludge treatment on enteric viruses can be assessed. The proportion of influent enteroviruses found viable in settled activated sludge exceeded 150% whereas the proportion of influent total coliphages recovered from the sludge never exceeded 90% and was usually much less. This difference suggests that the activated sludge process is less antagonistic towards enteric viruses than it is towards the coliphages studied. If inactivation of coliphages continued to be rapid in the settled sludge, then these viruses would not be suitable indicators of enteric viruses in this residual. Before this coliphage can be used as an indicator of enteric viruses in wastewater treatment processes, the relationship between the two viral types in other unit processes and under varying environmental conditions must be known. (Baker-IVI)
W85-07113

CG-MS IDENTIFICATION OF ODOROUS VOLATILES IN WASTEWATER,
Ghent Rijksuniversiteit (Belgium). Lab. voor Organische Chemie.
H. Van Langenhove, K. Roelstraete, N. Schamp, and J. Houtmeyers.
Water Research, Vol. 19, No. 5, p 597-603, 1985. 4 Fig, 5 Tab, 16 Ref.

Descriptors: *Odor control, *Wastewater treatment, *Volatile acids, *Volatile solids, Wastewater analysis, Chromatography, Mass spectroscopy, Hydrocarbons, Oxygen, Nitrogen, Sulfur compounds, Organic compounds.

GC-MS analyses were made of water samples taken from all unit processes of a wastewater treatment plant receiving municipal as well as industrial wastewater. A wide variety of organic volatiles were identified in the samples. Aliphatic, aromatic and chlorinated hydrocarbons were the most widely dispersed species. These compounds do not seem to be very important with respect to the odor problem existing in the neighborhood of the wastewater treatment plant in question. Sulfides, polysulfides, alkylthiophenes, alkylthiothiophenes, organic acids, phenol and p-cresol were identified and selected as the most powerful organic odor stimuli present in the wastewater. Large variations in character and amounts of volatiles were observed. Some of these could be explained as a result of different oxidation reduction potentials present in different parts of the plant. Others could be explained as a result of anaerobic fermentation. The main reason for the existence of the odor problem was the mixing of two types of industrial wastewater and the long retention of this water in a sewer. (Baker-IVI)
W85-07119

SILVER COMPLEXATION IN RIVER WATERS OF CENTRAL NEW YORK,
State Univ. of New York at Binghamton. Dept. of Geological Sciences.
S. I. Whitlow, and D. L. Rice.
Water Research, Vol. 19, No. 5, p 619-626, 1985. 4 Fig, 4 Tab, 33 Ref. NOAA grant NA81AA-D-00089.

Descriptors: *Silver, *Complexation, *New York, *Susquehanna River, *Chenango River, Chemical speciation, Rivers, Metals, Water chemistry.

The dissolved component of the apparent silver complexation capacity was determined for Susquehanna and Chenango River water samples collected over a 3-month period in the vicinity of Binghamton, New York. The study predicts that AgCl(0) and additional undetermined species are the major dissolved species of Ag in the two rivers. Little of the Ag(r) is present as Ag(+). The importance of long term studies in characterizing river water chemistry is emphasized by the variability in the apparent complexation capacity due to natural fluctuations in the concentration of the ligands complexing Ag, over the three-month period. The usefulness of ion-selective electrodes in determining the dissolved component of the apparent complexation capacity (if it is possible to work at low total metal concentrations and avoid precipitation of the metal) has been demonstrated. (Baker-IVI)
W85-07120

SOIL AMOEBAS AS BIOLOGICAL MARKERS TO ESTIMATE THE QUALITY OF SWIMMING POOL WATERS,

Dakar Univ. (Senegal). Dept. de Parasitologie.
A. N'Diaye, P. Georges, A. N'Go, and B. Festy.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1072-1075, May, 1985. 6 Tab, 19 Ref.

Descriptors: *Water quality, *Amoeba, *Protozoa, *Swimming pools, Recreational facilities, Epidemiology, Public health, Seasonal variation, Pathogenic protozoa.

A 12-month survey of 54 swimming pools was performed between March 1978 and March 1979 in Paris, France, and 765 superficial pool and tap water samples were collected. Because of the importance of swimming waters in the etiology of primary amoebic meningoencephalitis, the samples were filtered and cultured for amoebas. Important differences in the quality of the tap waters supplying the pools were observed. These differences depended on the origins of the tap water and also on the season. Differences in tap water sources affected the quality of the swimming pool waters as well. For each swimming pool, tap and pool water samples were collected simultaneously. Seasonal variations indicated that tap water was significantly more contaminated during the summer. The data suggest that filters were not always protective against a high concentration of amoebas. The disinfection procedures were not equally efficient according to estimates based on biological criteria. The numeration of soil amoebas is useful as an additional biological marker to estimate the quality of swimming pool water. (Baker-IVI)
W85-07126

USE OF BITUMINOUS COAL AS AN ALTERNATIVE TECHNIQUE FOR FIELD CONCENTRATION OF WATERBORNE VIRUSES,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Virology Section.
D. R. Dahling, P. M. Phirke, B. A. Wright, and R. S. Safferman.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1222-1225, May 1985. 4 Tab, 21 Ref.

Descriptors: *Viruses, *Pollutant identification, *Coal filters, Drinking water, Public health, Filters, Water analysis, Bituminous coal, Costs, Developing countries.

A filter system that sandwiches a bituminous coal preparation between two prefilters was compared to those presently in use to recover human viruses from large volumes of water. An initial series of studies with the coal filters prepared between 47-mm AP20 prefilters showed that good virus recoveries in water conditioned with MgCl2 occurred from pH 3.0 through 7.0, with the greatest recoveries from pH 3.5 through 6.0. Within this range, all values showed about the same rate of recovery, which led to the selection of the high and low pH values, pH 3.5 and 6.0, to condition water in subsequent tests. In the same series of studies, use of unconditioned tap water (no MgCl2) resulted in lower virus recovery, which ranged from 5% at pH 8 to 26% at pH 5. The coal filter proved a viable alternative to the other types of filters tested. In tap water studies no significant differences in virus recovery were observed between the bituminous coal and Filterite cartridge filter. Flow rates were comparable in this study. If either sample turbidity or volume is increased appreciably, disk filters such as the bituminous coal system do not compare favorably to the cartridge filter in either volume processed or flow rate. The effectiveness of the coal filter for sewage effluent is evident from the data presented. A major advantage of the coal filter is that elution requires only 4 ml of eluent and, as opposed to cartridge filters, no secondary reconcentration steps are needed. Another advantage is the low cost of the coal filter, making it applicable to developing countries. (Baker-IVI)
W85-07129

INSTRUMENT FOR THE IMMEDIATE QUANTIFICATION OF BACTERIA IN POTABLE WATERS,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
C. Wallis, and J. L. Melnick.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1251-1253, May, 1985. 3 Fig, 14 Ref.

Descriptors: *Bacteria, *Measuring instruments, *Potable water, Water analysis, Colorimetry, Bacterial analysis.

A new semiautomated instrument is described which quantifies the number of bacteria in potable waters within 3 min, providing a permanent colorimetric record of the results. The bacteria detection device can measure as few as 100 CFU/ml in potable waters. The sample is siphoned through the bacteria-concentrating filter. The filter, which is impacted with bacteria, rust, and organic compounds indigenous to natural waters, is treated with the reducing agent to remove those contaminants without affecting the bacteria. The filter is inverted, the bacteria thereon are backflushed with eluent, and the eluate is recovered in the eluate holder within the device. The eluate is then passed through a 7 mm diameter reconcentrating filter. The bacteria on the filter are stained, the filter fibers are decolorized, and the color intensity of the filter surface is compared with that of the standardized color guide imprinted on the test card. The color guide is calibrated to indicate the number of bacteria per milliliter of the original water sample when a 100-ml sample is processed through the apparatus. If a 1,000 ml sample is used, the result should be recorded as 10-fold less than that indicated on the color guide. (Baker-IVI)
W85-07130

EFFECTS OF HUMIC MATERIALS ON VIRUS RECOVERY FROM WATER,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
N. Guttman-Bass, and J. Catalano-Sherman.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1260-1264, May, 1985. 3 Fig, 3 Tab, 21 Ref. EPA grant CR-806588-03-2.

Descriptors: *Water analysis, *Viruses, *Humic acids, *Fulvic acid, *Filters, Microporous filter, Filtration, Zeta Plus Filters, Seitz S Filters.

The effects of humic materials on virus recovery by four types of microporous filter were investigated. Humic acid interfered with virus recovery by all four filter types, whereas fulvic acid had no effect on recovery by the two types of filter (Balston and Zeta Plus) which were tested. The negatively charged filters were more sensitive to interference by humic acid than were the positively charged filters at all concentrations of humic acid tested. Recovery by Balston filters was inhibited at concentrations as low as 10 mg of humic acid per liter, whereas the Zeta Plan filters recovered essentially all of the virus at humic acid concentrations of up to 50 mg/liter. At higher humic acid concentrations, less than 10% of the virus was recovered by the Balston filters, whereas the positively charged filters continued to recover 30% or more of the virus. In both cases, the primary level of interference was prevention of virus adsorption, since the virus not found in the eluate could generally be accounted for by the amount of virus in the filtrate. The results obtained with electronegatively charged filters suggests a relatively simple mechanism of interference, in which the humic acid, which bound to the Balston filters, prevented virus adsorption by occupying virus attachment sites. The virus and humic acid sites of attachment to the filter would be the same, and interference would be due to direct competition for available sites. (Baker-IVI)
W85-07131

INTERACTIONS BETWEEN HETEROTROPHIC PLATE COUNT BACTERIA AND COLIFORM ORGANISMS,
Montana State Univ., Bozeman. Dept. of Microbiology.
M. W. LeChevallier, and G. A. McFeters.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1338-1341, May, 1985. 3 Fig, 1 Tab, 22 Ref. EPA grant R807092.

Descriptors: *Coliforms, *Heterotrophic plate count bacteria, *Bacteria, Drinking water, Potable water, Bacterial analysis, Nutrients.

Some species and strains of bacteria have been shown to suppress coliform detection. The role of heterotrophic plate count (HPC) bacteria in causing injury to coliform bacteria was examined and the mechanism of coliform antagonism was investigated. Experiments were first designed to demonstrate coliform antagonism of injury in drinking water. Depending on the HPC, coliforms either died or became injured. As HPC densities approached 10,000 to 100,000 CFU/ml, coliform counts decreased at a rate of 0.5 log per day. Coliforms in pure culture remained constant over the 8 day period. No significant injury was detected in either the mixed- or the pure-culture coliform populations. Statistical analysis of 10 replicate experiments demonstrated a significant correlation between the initial HPC level and the rate of coliform decline. A laboratory controlled system for studing the interactions of HPCs with coliforms was developed. The results indicated that HPCs grew at low nutrient levels (0 to 2 mg of yeast extract per liter), whereas coliforms required 4 to 6 mg of yeast extract per liter to grow. Since coliforms have higher growth requirements than HPCs, they are particularly susceptible to competition for nutrients in oligotrophic environments such as drinking water. Similar results were obtained with experiments designed to determine the limiting glucose concentration necessary for the growth of coliforms and HPCs. (Baker-IVI)
W85-07133

APPLICATION OF A SIMPLIFIED METHOD FOR RECOVERY OF YERSINIA ENTEROCOLITICA FROM SURFACE WATERS,
Aquila Univ. (Italy). Ist. d'Igiene.
G. Marinelli, C. D'Innocenzo, L. Fabiani, and V. Leoni.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1348-1349, May, 1985. 2 Tab, 19 Ref.

Descriptors: *Surface waters, *Yersinia, *Bacterial analysis, *Aterno River, *L'Aquila, *Italy, Public health, Water analysis, Sampling.

Yersinia enterocolitica was recovered from surface water by a simplified method: samples were taken by means of the Moore tampon and, after a short, warm preincubation in peptone-sorbitol-bile salts broth, were quickly passed to an alkali solution. Immediately after this, samples were directly plated on MacConkey agar. Y. enterocolitica was isolated from 60% of the water samples, and the identification confirmation of the strains chosen was 100%. The greatest number of Yersinia strains was isolated from the surface water taken at sampling station A, a point before the town effluent joins the river. When this is compared with other sampling stations, it might suggest that there are life-competition phenomena, chemical toxicity, dilution in the river, or all of these after the urban drain discharges. These phenomena probably adversely influence Yersinia survival, but this hypothesis requires further examination. The substantial presence of Yersinia strains in the Aterno River may be attributed to the cold climate and the local economy based on agriculture and animal husbandry. (Baker-IVI)
W85-07135

NEW METHOD FOR MONITORING TEMPORAL TRENDS IN THE ACIDITY OF FRESH WATERS,
Lamont-Doherty Geological Observatory, Palisades, NY.
A. L. Herczeg, W. S. Broecker, R. F. Anderson, S. L. Schiff, and D. W. Schindler.
Nature, Vol. 315, No. 6015, p 133-135, May, 1985. 3 Fig, 16 Ref. NSF grant DEB 80 17639.

Descriptors: *Acidity, *Acid rain, *Monitoring, *Chemical properties, Acid precipitation, Lakes, Inorganic carbon, Dissolved solids, Carbon dioxide, Acidification.

Acid precipitation and the consequent increased acidity of fresh waters are subjects of widespread concern. Several organizations in the United States, Canada and Europe have established extensive monitoring programs in an attempt to determine the relationship between the acidity of pre-

cipitation and the change in acidity of fresh waters. It is contended that the present strategies for monitoring temporal trends in the acidity of fresh waters will not yield results sensitive enough to detect trends in acidity even on a 10-year timescale. An alternative scheme is proposed, based on calculations using precise measurements of dissolved inorganic carbon (DIC) and partial pressure of CO2 (P CO2). This scheme eliminates biases inherent in pH electrode determinations and minimizes the perturbations in acidity caused by changes in the P CO2 of lake waters associated with biological cycles. (Author's abstract)
W85-07143

ISOLATION OF ORGANIC MATERIAL FROM WATER,
Mainz Univ. (Germany, F.R.). Hygiene Inst.
H. Kunte, and E. H. Pfeiffer.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 650-655, May, 1985. 2 Tab, 13 Ref.

Descriptors: *Organic matter, *Water analysis, Dissolved solids, Adsorption, Water quality, Water chemistry, Organic matter.

Various methods for concentrating or isolating organics from water samples are compared with respect to recovery of total organic matter from water using dissolved organic carbon as a criterion of effectivity. UV absorbance, gas chromatography and recovery of added chemicals were used for additional information. Recovery rates of added chemicals are given for four different sorption procedures: a combination of XAD 2 and XAD 7 and neutral pH of the sample; the same, followed, after acidification to pH 2 to 3, by a second column of the same material; followed after acidification, by a column with Amberlite IRA 401S; and a mixture of XAD 4 + XAD 8 at neutral and acid pH. An additional adsorption step does not significantly improve the recovery rates. About 35% of the organic carbon in water can be recovered by a simple XAD resin adsorption procedure. This is comparable to the recovery rates obtained with freeze concentration at a concentration factor of 50, and with lyophilization, if the organic material is extracted. (Baker-IVI)
W85-07150

TOXICITY OF EIGHT WATER-SOLUBLE ORGANIC CHEMICALS TO SELENASTRUM CAPRICORNUTUM: A STUDY OF METHODS OF CALCULATING TOXIC VALUES USING DIFFERENT GROWTH PARAMETERS,
Building Research Establishment, Princes Risborough (England). Princes Risborough Lab.
N. Adams, K. H. Goulding, and A. J. Dobbs.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 333-345, May, 1985. 6 Fig, 5 Tab, 23 Ref, 1 Append.

Descriptors: *Phytotoxicity, *Selenastrum, *Algal growth, Toxicity, Organic compounds, Algae, Monitoring.

The need for a reliable algal toxicity test to support environmental monitoring programs is well established, but the effect of differences in methods for calculating quantitative toxic values of test chemicals is not known. Standard toxicity experiments were carried out using Selenastrum capricornutum and eight water-soluble organic chemicals in order to evaluate different methods of quantifying toxic response. There are two types of toxic values. The EC50 type are values interpolated from data from a range of chemical concentrations. The reported value is an estimate of the concentration that would cause the effect reported. The 'significant effect' type values (such as lowest concentration tested with a significant effect or algistatic concentration) are concentrations of chemical actually tested in an experiment with no extrapolation or interpolation. A multiple comparison method which gives 'no effect concentrations' and 'lowest concentrations with an observable effect' is chosen as a preferable method to those which involve interpolation, as would be the case for EC50 determinations. The area under the growth curve is more sensitive than either cell counts from a single point or growth rates for the detection of toxic effect. (Moore-IVI)
W85-07159

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY WITH HYDRIDE GENERATION/ATOMIC ABSORPTION SPECTROMETRY FOR THE DETERMINATION OF ARSENIC SPECIES WITH APPLICATION TO SOME WATER SAMPLES,
Plymouth Polytechnic (England). John Graymore Chemical Lab.
C. T. Tye, S. J. Haswell, P. O'Neill, and K. C. C. Bancroft.
Analytica Chimica Acta, Vol. 169, p 195-200, March, 1985. 3 Fig, 26 Ref.

Descriptors: *Pollutant identification, *High-performance liquid chromatography, *Atomic absorption spectrometry, *Arsenic, Chromatography, Spectrometry, Pesticides, Water analysis, Bottled water, Drinking water, Soil water.

High performance liquid chromatography is used for separation of arsenite, arsenate, monomethylarsinate and dimethylarsonate followed by continuous sodium tetrahydroborate reduction and atomic absorption spectrometric detection. Preconcentration is done on Zipax, a pellicular anion-exchange material, and the separation on a column packed with h.p.l.c.-grade strong anion-exchange resin. The Zipax column has the added advantage of acting as a guard column for the following column. The detection limits, based on the concentration of arsenic corresponding to twice the standard deviation of replicate analyses of known, low standards were 2 ng As for aresnite, arsenate and MMA, and 1 ng for DMA. The sensitivity of the method was dependent on the design of the gas-liquid separator. Small changes in the dimensions and geometry of the separator could make changes in peak height sensitivity of up to an order of magnitude. Soil waters and commercial bottled waters were analyzed for arsenic species by the method described. The concentrations of the arsenic species found for the water logged soil sample were 15 micro-g As/l as arsenite, 5 micro-g As/l as MMA, and 30 micro-g As/l as arsenate. Typical values for a similar but drier soil were 2 micro-g As/l as arsenite and 35 micro-g As/l as arsenate. Results of ten commercial bottled water analyzes showed that almost all the waters contained < 1 micro-g/liter total arsenic. Vichy water contained an average of 180 micro-g/l total arsenic. For the Vichy waters, > 90% of the total reducible arsenic was present as arsenate with the remainder being arsenite. (Baker-IVI)
W85-07162

VOLTAMMETRIC MEASUREMENT OF COPPER(II)/ORGANIC INTERACTIONS IN ESTUARINE WATERS,
Institute for Marine Environmental Research, Plymouth (England).
A. Nelson.
Analytical Chimica Acta, Vol. 169, p 287-298, March, 1985. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Copper, *Voltammetry, *Estuaries, *Organic compounds, Trace metals, Surface waters, Water analysis, Pollutant identification.

The voltammetry of copper in organic ligand/chloride media is dominated by the formation of CuCl2(-) species and by induced adsorption of Cu(I) in organic coatings on the electrodes. The method is based on the induced adsorption of CuCl2(-) from Cu(II) species in solution on an organically-coated positively-charged hanging mercury drop electrode (HMDE). The approach as described takes advantage of the anomalies of copper interfacial electrochemistry. The method provides meaningful response when tested on pure ligands in surfactant/chloride media and on estuarine waters. The technique gives both a diagnostic criterion on the nature of the Cu(II)-binding ligands and also an estimate of the complexation capacity and binding constants. Estuarine waters appear to contain two populations of Cu(II)-binding ligands: a high concentration of humic material with polyelectrolyte-type binding, and a lower level of discrete ligands forming copper complexes with stability constants around 10 to the 9th power. The extent of Cu(II) binding by the humic material decreased down the estuary because of dilution and increased competition from metal ions. (Baker-IVI)
W85-07163

DETERMINATION OF ALIPHATIC ALDEHYDES IN WATERS BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Studiesyndicaat voor Water, Antwerp (Belgium).
F. Van Hoof, A. Wittocx, E. Van Buggenhout, and J. Janssens.
Analytica Chimica Acta, Vol. 169, p 419-424, March, 1985. 2 Tab, 14 Ref.

Descriptors: *Water analysis, *Chromatography, *Aldehydes, *High-performance liquid chromatography, Organic compounds, Pollutant identification, Surface waters, Drinking water, Humic acids, Ozone.

A method is described for the determination of linear aldehydes in water. In this method the aldehydes are derivatized with 2,4-dinitrophenylhydrazine and extracted with n-pentane. The determination is completed by reversed-phase high-performance liquid chromatography with detection at 365 nm. The method was assessed for different aldehydes and applied to surface waters, treated water and humic acid solutions after ozonization. With a 250 ml sample, the limit of detection is 1 micro-g/l for the C1-C3 aldehydes. Analysis of different surface waters, treated water and a humic acid solution after ozonization showed that C1-C3 aldehydes predominated, their concentration increasing with increasing ozone dosage. (Baker-IVI)
W85-07164

5B. Sources Of Pollution

NOTE ON YERSINIA ENTEROCOLITICA IN A SWINE FARM WATERSHED,
P. J. Walker, and D. J. Grimes.
Journal of Applied Bacteriology, Vol. 58, No. 2, p 139-143, February, 1985. 1 Tab, 27 Ref.

Descriptors: *Animal wastes, *Yersinia, *Agricultural watersheds, *La Cross River, *Wisconsin, Water pollution sources, Public health, Runoff, Path of pollutants, Pigs.

Swine feces from three pig farms in the La Crosse River watershed near La Crosse, Wisconsin, were sampled for Yersinia enterocolitica; 19 presumptive isolates were recovered and biochemically confirmed as Y. enterocolitica. Simultaneously, during a 2.2 cm rainfall, the confluences of runoff water flowing from the swine holding pens and of nearby streams were also sampled; a single isolate was obtained from one holding pen runoff-stream confluence. Biochemical analysis showed that the water isolate was a biotype identical with that of a swine isolate from the adjacent farm. These results demonstrate one possible mechanism for the introduction of Y. enterocolitica into water supplies; fecal material from swine, a suspected natural reservoir of the bacterium, is transported via runoff water to streams. (Author's abstract)
W85-06179

POTENTIAL SITES OF GEOSMIN PRODUCTION BY STREPTOMYCETES IN AND AROUND RESERVOIRS,
Macaulay Inst. for Soil Research, Aberdeen (Scotland). Dept. of Microbiology.
S. Wood, S. T. Williams, and W. R. White.
Journal of Applied Bacteriology, Vol. 58, No. 3, p 319-326, March, 1985. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Geosmin, *Streptomycetes, *Reservoirs, *Longridge, *England, Odor, Water pollution sources, Water quality, Nutrients, Sediments, Soil, Vegetation, Detritus.

Water from several oligotrophic reservoirs of the North West Water Authority at Longridge, Lancashire (England), supported only sparse growth of

streptomycetes isolated from the reservoirs. Growth was enhance by nutrient-amendment of the water and one common isolate, identified as Streptomyces albidoflavus, produced geosmin in water which was supplemented with sufficient concentrations of available carbon, nitrogen and phosphorus. The minimum concentrations required for geosmin production were higher than those recorded in natural reservoir water. Synthesis of geosmin in water also required a minimum temperature about 15 C. Sterilized samples of reservoir sediment, sediment extract, plant debris from banks and surrounding soil also supported geosmin production by S. albidoflavus. Both bank debris and exposed sediment developed earthy odors without inoculation. The structure of reservoir banks influenced the quantity of plant growth and accumulation of litter, and there also the potential for contamination of reservoir water by geosmin. The potential of these various sites of geosimin production to contaminate reservoir water is assessed. (Author's abstract)
W85-06181

DRAINAGE LOSSES OF POTASSIUM FROM A YELLOW-GREY EARTH SOIL,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 2K.
W85-06183

EFFECTS OF SEDIMENT SORPTION AND ABIOTIC HYDROLYSES. I. ORGANOPHOSPHOROTHIOATE ESTERS,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
D. L. Macalady, and N. L. Wolfe.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 1, p 167-173, 1985. 5 Fig, 6 Tab, 17 Ref.

Descriptors: *Fate of pollutants, *Hydrolysis, *Sediments, *Sorption, *Organophosphorothioate esters, Organic compounds, Sediment-water interfaces, Chlorpyrifos, Diazinon, Ronnel, Chemical kinetics.

In sediment-water systems it is generally assumed that organic compounds do not hydrolyze in the sediment-sorbed state but that the compound is in rapid equilibrium between the sediment and aqueous phases and hydrolysis occurs only through the aqueous phase. The kinetics of hydrolysis of selected organophosphorothioate insecticides were determined in sediment-water samples to define the role of hydrolysis in the sediment-sorbed state. Investigations with well-characterized sediments showed that the rates of neutral hydrolysis of chlorpyrifos, diazinon, and Ronnel are unaltered when the compounds are sorbed to sediments. For chlorpyrifos, the observed rate constants were the same in the sediment and aqueous phases and similar in magnitude to those found for natural water samples. Limited data for diazinon and Ronnel indicated similar kinetic behavior for these related compounds. Alkaline hydrolysis rates in the sediment-sorbed phase for chlorpyrifos, on the other hand, were slowed considerably relative to those in aqueous phase. The rate of alkaline hydrolysis in the sorbed state is approximately 10 times slower than in the bulk solution. In pollutant fate modeling, the neutral hydrolysis process can be simulated by assuming equilibrium between the aqueous and sediment phase with hydrolysis occurring in both phases with the same disappearance rate constant. For describing the fate of organophosphorothioate in sediments, a model with partitioning of the ester to the sediment with reaction in the aqueous phase only is adequate. (Moore-IVI)
W85-06249

OCCURRENCE AND ASSESSMENT OF POLYCYCLIC AROMATIC HYDROCARBONS IN A RIVER LOADED WITH MUNICIPAL AND INDUSTRIAL WASTEWATER (VORKOMMEN UND BEWERTUNG POLYZYKLISCHER AROMATISCHER KOHLENWASSERSTOFFE IN EINEM MIT KOMMUNALEN UND INDUSTRIELLEN ABWASSERN BELASTETEN FLIESSGEWASSER),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
A. Lawerenz.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 259-268, 1983. 5 Fig, 3 Tab, 21 Ref.

Descriptors: *Polycyclic aromatic hydrocarbons, *Carcinogens, *Fate of pollutants, *Water pollution sources, Industrial wastewater, Municipal wastes, Pollution load.

A river with a catchment of 5,400 sq km was investigated over a length of 230 km at seven stations for the total concentration of six polycyclic aromatic hydrocarbons (PAH) and the total of three carcinogenic polycyclic substances (CPS) in the water by mean of thin-layer chromatography. The maximum load occurs in the lower course downstream of large industrial wastewater introduction points with 5.1 micro-g/l polycyclic aromatic hydrocarbons, whereas in the upper course the maxima are at 2 to 3 micro-g/l polycyclic aromatic hydrocarbons mainly from municipal pollution. The average daily load increases from 0.146 kg/d PAH and 0.048 kg/d CPS to 4.168 and 1.401 kg/d, respectively. In the flowing water there cannot be observed any self-purification concerning these substances; an interconnected storage reservoir reduces seston and thus also the PAC-concentrations are reduced by 50 to 60%. The PAH-concentration shows a significant positive correlation with the COD-Mn and the ammonium concentration. There is also a good agreement between the concentrations measured and the concentrations calculated from the wastewater load in the longitudinal section of the river. (Author's abstract)
W85-06258

LEACHING OF SEVERAL INSECTICIDES FROM AN AGRICULTURALLY USED SOIL IN LYSIMETER STUDIES (AUSWASCHUNG EINIGER INSEKTIZIDE AUS LANDWIRTSCHAFTLICH GENUTZTEN BODEN IM LYSIMETERVERSUCH),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
G. Schmaland.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 269-278, 1983. 3 Fig, 7 Tab, 4 Ref.

Descriptors: *Leachates, *Insecticides, *Toxicity, *Soil types, Lysimeters, Degradation, Pesticide residues, Toxaphene, Lindane, Butonate, Trichlorphon, Methylparathion, Dimethoate.

Six lysimeters filled with loam and seven lysimeters filled with sand, having an area of 1 sq m and a depth of 1 m, were agriculturally used and in July of 1976, 1977, and 1979, they were treated with the following agents (g/sq m): toxaphene (0.75, 0.36), lindane (0.05), butonate (0.09), trichlorphon (0.07), methylparathion (0.045, 0.03) and dimethoate (0.17). The percolates accumulated on the lysimeter bottom were drained off monthly and investigated in toxicological tests with Poecilia and Daphnia. The lasting precipitation in 1978 and 1977 resulted in 1978 in percolates with a toxic effect for several months. The July insecticide applications of 1979 resulted in toxic percolates from December 1979 to May 1980. Compared with sand, loamy soils have shown only a time delay of toxicity, but no decrease of it. To assess the results, the theoretical average maximum concentration (quantity used:annual runoff) is compared with LC50 of the substances, solved in percolates of untreated lysimeters. For the organophosphorus insecticides, either other substances contained in the percolates act synergistically or toxicity is increased by degradation products such as Paraoxon. In general, a toxipotent penetration of the insecticides into the ground water is possible. (Author's abstract)
W85-06259

CONCENTRATIONS OF CADMIUM, LEAD AND COPPER IN FILTRATED BALTIC SEA WATER SAMPLES COLLECTED AT TWO SEASONS IN 1969,
Uppsala Univ. (Sweden). Dept. of Analytical Chemistry.
I. Gustavsson.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 309-317, 1983. 2 Fig, 2 Tab, 21 Ref.

Descriptors: *Baltic Sea, *Cadmium, *Lead, *Copper, *Seawater, Atomic absorption spectrophotometry, Voltammetry, Heavy metals, Seasonal variation, Water pollution.

Two research cruises on the Baltic Sea, in July and November of 1979, were made for investigating the Baltic Sea water for its contents of dissolved cadmium, lead and copper. Atomic absorption spectrophotometry and voltammetry were used as methods of investigation, the latter method having supplied slightly lower results. In the water layer of 0-50 m the cadmium concentrations were 0.03-0.05 micro-g/l and the lead concentrations were 0.1-0.2 micro-g/l, seasonal changes did not have any effect on them. The copper concentrations, on the other hand, were 0.4-1.2 micro-g/l in summer and 0.1-0.7 micro-g/l in autumm. Compared with ocean waters, the lead content is remarkably high. In anoxic deep waters of the Baltic Sea the concentrations of the three metals, especially that of cadmium, are very low (< 0.01 micro-g/l). (Author's abstract)
W85-06261

ESTIMATION OF THE MERCURY CONTENT IN THE WATERS OF THE POMERANIAN BALTIC-SHORE-AREA,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Physics.
H. Z. Wrembel.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 5, p 523-538, 1983. 7 Fig, 7 Tab, 68 Ref.

Descriptors: *Pomeranian Bay, *Baltic Sea, *Coastal waters, *Mercury, Heavy metals, Water pollution sources, Seasonal variation, Rivers, Precipitation, Marine environment, Estuarine environment, Particulate matter.

In the catchment area of the Pomeranian Bay an average mercury concentration of 178 ng/l in precipitation was determined. Eight different flowing waters showed mean concentrations between 105 ng/l (Lupawa) and 500 ng/l (Odra), a pronounced annual cycle having been demonstrated for the concentrations and for the loads with the minimum in February/March and the maximum in August/September. The total load of the eight rivers amounts to 19.5 t/a, the share of the Wisla being 11 t/a. The ratio between the mercury in precipitation (335 to 410 micro-g Hg/sq m/a) and in the run-off (30-75 micro-g Hg/sq m/a) for the individual river basins varies between 0.08 and 0.21. In the Baltic Sea, the mercury concentrations are 40 ng/l in the open sea, 50 ng/l in the coastal region and 290-390 ng/l near the estuaries. Through the eight investigated rivers about 48 cu km/a water runs off into the Baltic Sea with about 20 t/a Hg. The total introduction of Hg into the Baltic Sea is estimated at 100 t/a with the river water, 35 t/a with precipitation and 35 t/a with dust. (Author's abstract)
W85-06273

NUTRIENT INPUTS AND OUTPUTS IN A FORESTED AND GRASSLAND CATCHMENT AT PLYNLIMON, MID WALES,
Institute of Hydrology, Wallingford (England).
G. Roberts, J. A. Hudson, and J. R. Blackie.
Agricultural Water Management, Vol. 9, No. 3, p 177-191, November, 1984. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Nutrients, *Forest watersheds, *Plynlimon, *Wales, Water analysis, Drainage, Agriculture, Seasonal variations, Water quality control, Water pollution sources, Nitrogen, Phosphorus, Potassium, Runoff, Leaching,.

Daily water samples, extracted over a 4 year period from streams draining rough pasture and forest in an upland area of Wales were analyzed for nitrogen, phosphorus, and potassium. A seasonal variation in nitrate-N concentration was formed in both streams - low in summer and high in winter. This was thought to be due to the hydrological response of the catchments and to the growth cycle of plants. In the growing season, any available nutrients within the rooting zone are rapidly

taken up by plants before thay can contribute to baseflow loads. In the winter, rapid runoff ensures that the concentrations in the streamflows are similar to those in the rainfall. Higher nitrate-N concentrations were found in the stream draining the forested catchment especially during 1976 and 1977. Two further studies were initiated to try to explain this difference. Throughfall samples were collected below the forest canopy and an areal sampling survey was made of both catchments. The results of these studies suggested that the difference could not be attributed to increased concentrations in throughfall but was due in part at least to the artificial surface drainage installed in parts of the forest to aid sampling development. This drainage aids nitrogen release to the stream while the mires in the grassland catchment act as nitrogen sinks. Enhanced organic N concentrations in the Wye catchment in 1977 were thought to be due to the leaching and erosion of dessicated peat. A comparison of nutrient inputs and outputs in rainfall and runoff from both catchments showed a net input of nutrients in the months April to October and a net output in November to March. An annual nutrient balance showed a net input of 7 kg/ha of nitrogen to both catchments, parity for potassium in the grassland and a small net input to the forested catchment. (Baker-IVI)
W85-06278

ACID RAIN AND DRINKING WATER DEGRADATION,
National Center for Atmospheric Research, Boulder, CO.
P. Middleton, and S. L. Rhodes.
Environmental Monitoring and Assessment, Vol. 4, No. 1, p 99-103, March, 1984. 15 Ref.

Descriptors: *Acid rain, *Drinking water, *Water pollution effects, *United States, *Sweden, Water treatment, Geography, Water quality control, Metals, Leaching, Water treatment, Water pollution control.

Acid deposition induced drinking water degradation is discussed with respect to the geographical extent of and the potential for dealing with possibly adverse human health impacts. Qualitative evidence from the northeastern United States and Sweden strongly suggests a cause-and-effect link between acid deposition, metal leaching due to acid water, contamination of drinking water, and human effects, but quantitative evidence is not yet available. Standard responses to water quality problems are water treatment and/or regulation of the sources of contaminants. Proposed responses to acid deposition impacts are similar including the treatment of the affected areas and/or control of the atmospheric emissions causing the problems. Clearly the reduction of acid deposition is more comprehensive and has positive benefits for more than just drinking water. The second general solution, water treatment, at least appears to be more viable. The existence of appropriate water treatment practices does not mean that treatment is necessarily desirable on a large scale. Economic costs, time scales of implementing the controls, and side effects associated with particular treatment practice require investigation before water treatment is embraced as an accepted solution to any acid rain-drinking water problem. (Baker-IVI)
W85-06286

STATISTICAL COMPARISON OF HEAVY METAL CONCENTRATIONS IN VARIOUS LOUISIANA SEDIMENTS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
K. D. White, and M. E. Tittlebaum.
Environmental Monitoring and Assessment, Vol. 4, No. 2, p 163-170, June, 1984. 7 Tab, 7 Ref.

Descriptors: *Heavy metals, *Sediments, *Louisiana, Mississippi River, Lead, Zinc, Cadmium, Statistical analysis, Fate of pollutants.

Statistical 't' tests were used to determined lead, zinc, and cadmium enrichment in various Louisiana sediments. Both absolute metal concentrations and trace metal/conservative metal concentration ratios were used in comparing sampled sites to a 110 m deep background core taken just off the mouth of the Mississippi River. Concentration ratios were used to reduce the effects of certain chemical and physical sediment characteristics on the quantity of metal contained in a given sediment. Results from the comparison of sample sites to the background reveal metal enrichment at several sites. The University Lake sampling sites exhibit both lead and zinc enrichment when using both the concentration alone and ratio methods of comparison. Additionally, cadmium enrichment is indicated in the sediments of University Lake when using only the ratio method of comparisons. Several samples sediments in and around the New Orleans metropolitan area exhibited lead and cadmium enrichment. (Author's abstract)
W85-06289

MIGRATION OF POLLUTANTS IN GROUNDWATER. II. ADSORBABLE POLLUTANTS AND NUMERICAL DISPERSION REDUCTION,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
K. N. Carter, Jr., M. Saenz, D. J. Wilson, and P. W. Rosten, Jr.
Environmental Monitoring and Assessment, Vol. 4, No. 2, p 171-202, June, 1984. 22 Fig, 2 Tab, 14 Ref.

Descriptors: *Path of pollutants, *Groundwater pollution *Adsorption, *Dispersion, Mathematical equations, Advection, Aquifers, Decomposition, Solute transport, Velocity.

The partial differential equations governing the migration of decomposing pollutant adsorbing according to a Langmuir isotherm and undergoing 2-dimensional flow in a saturated aquifer are discussed. The equation governing the mass transfer of the pollutant to the surfaces within the aquifer are solved in closed form, permitting the use of larger values of the time increment Delta t in the numerical integration of the dispersion-advection equation governing the behavior of the dissolved pollutant. In this numerical integration transverse numerical dispersion is eliminated by using conformal coordinates (velocity potential and stream function), and longitudinal numerical dispersion is very substantially reduced by use of an asymmetrical 4-point formula to represent the advection term. Some representative results are given as contour maps. The mass transfer rate coefficient is estimated as the least positive eigenvalue of a diffusion problem. (Author's abstract)
W85-06290

ALKALINITY AND CHEMICAL OXYGEN DEMAND IN SOME FINNISH RIVERS DURING THE PERIODS 1911-1931 AND 1962-1979,
Water District Office of Oulu (Finland).
E. Alasaarela, and P. Heinonen.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 3-13, 1984. 5 Fig, 1 Tab, 19 Ref, 2 Append.

Descriptors: *Alkalinity, *Chemical oxygen demand, *Rivers, *Finland, Water quality, Water pollution, Acid rain, Effluents, Acidification, Acidic sulfate lands, Drainage, Dam effects.

Water quality in the important Finnish rivers discharging into the Gulf of Bothnia was investigated by the Hydrographical Bureau over the years 1911-1931. Observations were made at monthly intervals at the river mouths. In the present report a comparison is made between this old data and more recent water quality data collected during the period 1962-1979 as part of a national survey of the quality of river waters carried out by the National Board of Waters. Of the different quality variables, only alkalinity and chemical oxygen demand (COD) are discussed in this context because the analysis methods used during the two data collection periods are directly comparable. Alkalinity was found to have decreased at all the sites investigated, the least change being observed in areas in which effluent or non-point loading had increased. From the point of view of the deleterious effects of acidity, the situation has reached a serious level in a watercourse with an input from acidic sulfate lands. The least disturbing acidity levels were measured in the larger rivers of northern Finland, although even in these rivers the effects of acid rain are already discernable. Material flows of COD have decreased in the larger rivers. Due to the effects of drainage, COD values have in most cases increased during the time of the spring flood, whereas in summer and in many rivers also in winter the COD of the waters has decreased during the twentieth century. Increase in COD has only occurred in watercourses in which loading has increased due to effluents or to the construction of reservoirs. (Author's abstract)
W85-06291

CONTRIBUTION OF AGRICULTURAL LOADING TO THE DETERIORATION OF SURFACE WATERS IN FINLAND,
L. Kauppi.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 24-30, 1984. 6 Fig, 1 Tab, 18 Ref.

Descriptors: *Water pollution sources, *Agriculture, *Finland, Nonpoint-pollution sources, Fertilizers, Phosphorus, Nitrogen, Surface waters, Nitrates, Agricultural runoff, Algal growth.

Agriculture accounts for 9% of the total land area of Finland, and use of fertilizers in agriculture has more than doubled since 1960, thus increasing potential pollution. A move towards larger and more specialized production units in agriculture may also cause water pollution problems. Point source phosphorus loading of lakes and rivers has decreased during the nineteen-seventies, increasing the relative importance of non-point loading. The contribution of agricultural phosphorus and nitrogen loading to the deterioration of Finnish lakes was studied. Agriculture comprises the greatest single source of nutrients released into Finnish watercourses. Approximately 31,000 t of nitrogen and 1,400 t of phosphorus enter the watercourses annually due to agricultural activity. These estimates were based on the specific loads of 12 kg/ha/a nitrogen and 0.57 kg/ha/a phosphorus for cultivated land. Although most of the nitrogen coming from agricultural fields was in the form of nitrate, the amounts were so low that the concentrations remained well below the harmful level. A major fraction of the phosphorus in agricultural runoff enters the watercourses adsorbed to soil particles. Experimental results indicated that 60-70% of the total phosphorus was available for algae growth. The concentrations of available P remained so low that they could be achieved in Finnish lakes of low ionic concentration through chemical desorption without the assistance of the metabolic activities of algae. (Moore-IVI)
W85-06292

NITRATE IN RUNOFF AND RIVER WATERS IN FINLAND IN THE 1960'S AND 1970'S,
L. Kauppi.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 31-40, 1984. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Nitrates, *Runoff, *Rivers, *Finland, Water pollution sources, Agriculture, Fertilizers, Atmospheric deposition, Nitrogen, Agricultural runoff.

Nitrate concentrations and their changes in runoff waters from 31 small hydrological basins and in 19 rivers were studied. Average concentrations varied from 21 to 1800 micro-g/l in runoff waters and from 53 to 2100 micro-g/l in rivers. In general, the concentrations were well below the drinking water standards. Agriculture was an important contributor to the nitrogen budget of the basins. Atmospheric deposition played a minor role, except that it might have caused the differences in NO3-concentrations observed between southern and northern non-cultivated areas. Nitrate concentrations increased statistically significantly in 15 small hydrological basins during the period 1966-1980. Most of the increases were observed in basins influenced by agriculture. The use of nitrogenous fertilizers increased strongly until 1976, but not subsequently. Trends were therefore also calculated separately for the periods 1966-1975 and 1976-1980. It was found that most of the increases during the period

1966-1980 occurred in fact during the first 10 years, indicating that the use of fertilizers was an important contributor to NO3-concentrations in waters. Nitrate concentrations increased during the monitoring period in only one river, the river Kymijoki. The absence of trends in rivers may be due to the short observation period, which started in most cases in the middle of the 1970's. (Author's abstract)
W85-06293

ROLE OF RUNOFF WATER PHOSPHORUS IN EUTROPHICATION,
L. Kauppi, and M. Niemi.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 41-51, 1984. 3 Fig, 6 Tab, 24 Ref.

Descriptors: *Runoff, *Eutrophication, *Algal growth, *Phosphorus, Agricultural runoff, Forest watersheds, Bioavailability, Nutrients, Wastewater pollution, Water temperature.

Spring and autumn runoff waters were sampled from five drainage basins ranging from forested to totally cultivated. The algal growth potentials (AGP) of the samples with and without filtering were measured using Selenastrum capricornutum as test organism. The effects of the runoff waters on the AGP of the water of an oligotrophic lake were studied by mixing 10% and 50% of runoff water into the lake water and measuring the AGP values of the mixtures. Sewage was used as a comparison. The AGP of the runoff water from the forested basin was about the same as that of the lake water. In spring samples, the AGP of the runoff water increased with increasing proportion of cultivated land in the basin. In autumn the AGP values were lower and the differences between the basins were smaller. The algal utilization of runoff water P was most efficient in the tests with 10% runoff water addition to the lake water. In spring the proportion of available P was on average 64% of the added total P and varied from 27 to 100%. In autumn all the runoff water P became available in the 10% mixture of 4 samples, but only 27% of total P in one case. In sewage tests the availability of P was 59-83% in the tests in which density of the algal population did not limit the utilization. The effect of the time delay between the maximum loading and the optimal algal growth temperature on the utilization of runoff water P was discussed. It was concluded that, if desorption can account for the solubilization of P the delay is not of great significance. (Author's abstract)
W85-06294

MODELING PHYSICS AND CHEMISTRY OF CONTAMINANT TRANSPORT IN THREE-DIMENSIONAL UNSATURATED GROUNDWATER FLOW,
Simons, Li and Associates, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 2F.
W85-06301

EFFECT OF RESERVOIR INDUCED CIRCULATION ON THE WATER QUALITY OF RECREATIONAL FRESHWATER EMBAYMENTS,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
L. Johnstone, and A. F. Babb.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157733/AS, Price codes: A07 in paper copy, A01 in microfiche. Washington Water Research Center, Pullman, Report 58, Jan 1984. 133 p, 39 Fig, 21 Tab, 31 Ref, 5 Append, Project No. OWRT B-087-WASH (1), Contract/Grant No. 14-34-0001-1276.

Descriptors: *Water pollution sources, *Recreation, *Swimming, Exchange, Mixing, Embayments, Flushing, Fecal coliforms, Water quality, Intestinal bacteria, Turbidity, Temperature, Freshwater, Reservoir, Nutrients, Algae.

A combined field and laboratory investigation was conducted to determine the relationship between water quality and exchange characteristics in freshwater recreational swim embayments in reservoirs. The quality of water in the swim embayment will be no better than that of the exchange water from the main channel. Numbers of fecal coliforms will increase to unacceptable concentrations under light swimmer loads when exchange is less than 23 percent of volume (24-hour period). 1 Exchange rates of 93 percent (24-hour period) produced acceptable water with peak swimmer loads of 100. At peak swimmer loads of 100 to 150, a minimum surface area of 225 square feet per swimmer is suggested for embayments of less than five acres with an exchange rate of 93 percent or greater. To optimize design for water quality enhancement, a historical bacteriological perspective must be established for the exchange water. Concentrations of intestinal bacteria, turbidity and temperature are the most useful water quality parameters when relating exchange rates to water quality in freshwater swim embayments. Both laboratory and field studies indicated that adequate exchange must be achieved by using the effect of reservoir flow-by velocity to produce circulation in the embayment. Water surface fluctuations in the reservoir are inadequate to create the desired exchange. Either large single or double openings are needed for adequate exchange.
W85-06317

REVIEW OF THE MUNICIPAL POLLUTION ABATEMENT PROGRAMS IN THE GREAT LAKES BASIN.
International Joint Commission-United States and Canada, Windsor (Ontario). Municipal Abatement Programs Task Force.
Report to the Great Lakes Water Quality Board, November 1983, 184 p and 43 p, 4 Fig, 26 Tab, 42 Ref, 6 Append. (in separate volume).

Descriptors: *Toxicity, *Sludge disposal, *Poisons, *Chemical wastes, *Municipal wastewater, *Phosphorus, Wastewater treatment, Wastewater facilities, Treatment plants, Suspended solids, Jurisdiction, Interagency cooperation, Great Lakes.

In 1978, Canada and the U.S. renewed their commitment to control phosphorus inputs. This signed agreement also focused attention on the toxic chemical contamination of the Great Lakes. A task force established by the International Joint Commission examined this problem in terms of municipal wastewater treatment, facilities, phosphorus measurements and controls, sludge disposal, and combined sewer overflows. The task force found there is relatively little quantitative data on the levels of toxic organic contaminants in municipal sludge. Moreover, there is a lack of information on the fate of and environmental effect of toxic organics applied to the land with municipal sludges. Over 95% of the major municipal wastewater treatment works in the Great Lakes basin provide the equivalent of secondary treatment. Phosphorus removal facilities are provided at 85% of the major sewage treatment works. These works provide 76% of the total design flow capacity in the Great Lakes basin. The equivalent of secondary treatment in Ontario currently means achieving BOD and suspended solids concentrations of 20 mg/l each and a total phosphorus concentration of 1.0 mg/l on an annual average basis. There is considerable variation in the effluent limits established for specific wastewater treatment dischargers. Of the 390 major municipal wastewater treatment facilities in the basin, 215 met all their effluent requirements in 1981, while 175 facilities did not. (Hawkins-Omniplan)
W85-06330

CALIFORNIA STATE MUSSEL WATCH, 1981-1983, BIENNIAL REPORT,
California State Water Resources Control Board, Sacramento, CA. Div. of Surveillance and Monitoring.
For primary bibliographic entry see Field 5C.
W85-06333

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
For primary bibliographic entry see Field 5G.
W85-06349

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, APPENDIX--DELAWARE RIVER BASIN,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
For primary bibliographic entry see Field 5G.
W85-06350

MICROSYSTEM SEDIMENT-WATER SIMULATION: A PRACTICAL TECHNIQUE FOR PREDICTING RESERVOIR WATER QUALITY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
D. Craft.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-83-12, October 1983. 7 p, 6 Fig, 6 Ref.

Descriptors: *Simulation, *Sedimentation, *Sediment-water interfaces, *Reservoirs, *Lake sediments, Hypolimnion, Water quality, Water chemistry.

Water quality at the bottom of a lake or reservoir may be conveniently simulated in a controlled laboratory environment using the technique of microsystem sediment-water simulation. The technique provides predictive data on planned or existing reservoirs and lakes by duplicating conditions expected at the sediment-water interface including anaerobic (chemically reducing) conditions which may occur in the hypolimnion during summer and winter stratification. Using many small sediment-water 'microsystems' allows for replication and the estimation of experimental error, as well as application of a variety of analytical chemical techniques for characterizing the simulation water. The relatively small size of microsystems offers economies of scale advantages compared to some previously suggested simulation techniques. Because all the microsystem water is prepared for chemical analyses, the problem of microstratification seen in larger sediment-water systems is reduced. Microsystems are easier to seal, which minimizes the chance of oxygen contamination. Data obtained using this technique represent worst case rather than actual water quality conditions.
W85-06358

WATER QUALITY ANALYSIS OF THE PASSAIC RIVER AT THE DIVERSION INTAKE OF THE PASSAIC VALLEY WATER COMMISSION.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
October 20, 1982. 16 p. 7 Fig, 4 Ref.

Descriptors: *Water pollution sources, *Rivers, *Streamflow, *Nonpoint pollution sources, *Biochemical oxygen demand, *Diversion, Water quality, Ammonia, Streams, Hydrocarbons, Carcenogens, Aquatic environment, Chlorination.

Water quality data were analyzed to determine specific pollution sources in the upstream drainage basin of the Passaic River in New Jersey. The Passaic Valley Water Commission (PVWC) currently diverts approximately 50 mgd of water from the Passaic River at Little Falls for water supply purposes. Because of the significant amount of point source loading in the river upstream of the PVWC intake, water quality varies with stream flow and temperature. According to PVWC records, the ammonia concentration at the PVWC intake was reported as high as 9.7 mg/l during the 1981 winter drought. Additions of chlorine to oxidize the excessive ammonia causes a significant increase in the formation of halogenated hydrocarbons, which are suspected carcinogens. The domestic dischargers upstream of Little Falls are estimated to generate more than 20 times the annual nonpoint BOD load, 27 times more phosphate, and 15 times more nitrogen than the nonpoint sources of pollution. When the long-term water quality trends of BOD5 and NH3-N are compared with the corresponding stream flow (on a 12-month average) measured at the same location, it is found that the stream flow has a direct effect on the water quality. The trend shows that the PVOC will intake water with a BOD5 greater than 6 mg/l and NH3-N greater than 3.5 mg/l,

under summer low flow periods. Nonpoint sources were found to be the major contributing source of nitrate to the Passaic River at Little Falls. Biological data showed the organic pollutants stressed the aquatic community in the vicinity of the PVWC intake. (Hawkins-Omniplan)
W85-06364

ACID DEPOSITION NEAR A SOUR GAS PLANT IN SOUTHWESTERN ALBERTA,
McKinnon, Allen and Associates Ltd., Calgary (Alberta).
C. M. L. Dufour, B. Chapman, J. A. Lore, and M. Nosal.
Water, Air, and Soil Pollution, Vol. 24, No. 4, p 361-373, April, 1985. 2 Fig, 7 Tab, 28 Ref.

Descriptors: *Water pollution sources, *Acid rain, *Alberta, *Natural gas, Hydrogen ion concentration, Sulfates, Rainfall.

Analysis of rainfall data collected at 9 sites within a 20 km radius of a sour gas plant during June, July and August of 1972, 1973, and 1982 indicates that acidic deposition could not be attributed to local plant emissions. Despite a significant increase in the magnitude of S emissions from the plant from 1972-1973 to 1982, the only significantly different results between these time periods are for precipitation pH. Site differences for total atmospheric sulfation did exist, with those sites downwind of the plant having higher exposure levels. The variations in precipitation results at all sites were similar and do not correspond to the variations in sulfation exposure levels. Deposition of H(+) ion is higher for 1972 and much lower in 1973 and 1982 than predictions and reports in the literature for the Canadian prairie provinces. Deposition of sulfate ion is on the low end of the range of values previously reported. There is no significant correlation between H(+) and SO4(2-) concentration in the samples. (Baker-IVI)
W85-06373

FATE OF RIVERINE NITRATE ENTERING AN ESTUARY: I. DENITRIFICATION AND NITROGEN BURIAL,
Louisiana State Univ., Baton Rouge. Lab. for Weland Soils and Sediments.
C. J. Smith, R. D. DeLaune, and W. H. Patrick, Jr.
Estuaries, Vol. 8, No. 1, p 15-21, March, 1985. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Estuaries, *Fate of pollutants, *Nitrates, *Atchafalaya River, Seasonal distribution, Denitrification, Nitrification, Sediments, Wetlands, Marshes.

Fate of riverine nitrate entering a well defined turbid estuary receiving discharges from the Atchafalaya River, a distributary of the Mississippi River, was determined. Seasonal distribution of NO3 and its transformations were measured in Four League Bay (9,300 ha). Denitrification was estimated by incubating wet samples in the presence of acetylene and monitoring N2O production. The annual sediment accumulation of N was also determined within the bay and within the adjacent marshes. Nitrogen accumulation ranged from 6.0 to 23 g N per sq m per yr on the marsh and 6.1 to 11.2 g N per sq m per yr in the bay. Denitrification in this system was controlled by the availability of NO3(-) with fluxes ranging from 2 to 70 ng N per g per hr. The annual (N2O + N2)-N emission was equivalent to 142 and 120 microg per g or 2.1 and 1.7 g N per sq m from the 5 bay and 5 marsh stations, respectively. Approximately 195000 kg N, predominantly as N2, is being returned to the atmosphere via denitrification. This is estimated to be equivalent to 50% of the riverine NO3(-) entering this estuary. A significant amount was also assimulated within the estuary. (Author's abstract)
W85-06412

PARTICULATES AND THE CYCLING OF LEAD IN ULLSWATER, CUMBRIA,
Westfield Coll., London (England). Dept. of Botany.
M. Everard, and P. Denny.
Freshwater Biology, Vol. 15, No. 2, p 215-226, April, 1985. 2 Fig, 9 Tab, 28 Ref.

Descriptors: *Lead, *Ullswater, *England, *Particulates, *Fate of pollutants, Sediments, Phytoplankton, Seston, Turbulence, Littoral zone, Heavy metals, Particle size.

The manner in which lead is redistributed within the littoral zones of a lake, Ullswater (England), having entered the lake from lead mining the catchment area, is considered. A proportion of the lead in the lake is still mobile even though the mines closed some 20 years ago. Most lead in the water seems to occur in particulate form. Sequential filtration of water samples revealed a range of particle sizes in suspension and particles are often a major component of the Aufwuchs, ecton and seston. Particles are subject to the antagonistic influences of turbuent suspension and gravitational settling. During periods of high turbulence, suspension predominates over settlement. In periods of calm the various component particulates of the homogenate separate out according to size- and density-related gravitational settlement rates. Although Aufwuchs and ecton have a degree of similarity, the Aufwuchs has an attached algal component, is more compact and is relatively immobile. The intimate contact between the two provides the mechanism for metal transfer to the Aufwuchs. Concentrations of lead in epilithic and epixylic Aufwuchs decrease from the inflow to the outflow. The ooze is a young, gelatinous deposit not yet incorporated into the firmer sediment but is in sufficiently intimate contact for mixing and metal exchange. The concentrations of lead in the ooze and interstitial water overlying contaminated sediments corroborates this and gives some indication of the quantities of lead that may enter the water column during turbulence. (Baker-IVI)
W85-06417

SORPTION AND LEACHING OF THREE NONFUMIGANT NEMATICIDES IN SOILS,
Florida Univ., Gainesville. Dept. of Soil Science.
J. N. Bilkert, and P. S. C. Rao.
Journal of Environmental Sciences and Health, Vol. B20, No. 1, p 1-26, February, 1985. 5 Fig, 6 Tab, 30 Ref.

Descriptors: *Sorption, *Fate of pollutants, *Pesticides, *Leaching, Organic compounds, Nematicides, Aldicarb, Oxamyl, Fenamiphos, Sand, Loam, Clay, Soil properties, Infiltration.

Sorption and leaching of three nonfumigant nematicides (aldicarb, oxamyl, and fenamiphos) were studied using three U.S. soils (Arredondo sand, Cecil sandy loam, and Webster silty clay loam). Equilibrium sorption coefficient (K) values, measured using the batch-slurry technique, were in the order: aldicarb, equal approximately to oxamyl << fenamiphos. Nematicide mobilities measured in soil columns during water infiltration were in the order: aldicarb approximately equal to oxamyl >> fenamiphos. This order was as anticipated from the K values. Leaching of aldicarb was also measured in a field microplot of Arredondo sand. Rapid leaching of aldicarb along with the infiltrating water, similar to that noted in packed soil columns, was observed. Data from the soil column and field leaching studies were used to evaluate a simple piston displacement model. The model accurately predicted the position of the wetting fronts, but underpredicted nematicide leaching. Analysis of the soil column data revealed that nematicide K values measured by the batch technique need to be adjusted by a factor of about 0.4 to accurately predict nematicide leaching in soil columns and a field microplot. The value of this factor was invariant with the soil-pesticide combination. The need for this adjustment factor and its applicability to other soils and pesticides needs to be carefully evaluated. (Author's abstract)
W85-06426

ADSORPTION AND DESORPTION OF POLYDIMETHYLSILOXANE, PCBS, CADMIUM NITRATE, COPPER SULFATE, NICKEL SULFATE AND ZINC NITRATE BY RIVER SURFACE SEDIMENTS,
Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
N. Watanabe, E. Sato, and Y. Ose.
Science of the Total Environment, Vol. 41, No. 2, p 153-161, February, 1985. 3 Fig, 2 Tab, 32 Ref.

Descriptors: *Adsorption, *Desorption, *Fate of pollutants, Polychlorinated biphenyls, Sulfates, Nitrates, River sediments, Siloxanes, Sediments, Solubility, Heavy metals, Sorption.

An investigation into the adsorption and desorption of polydimethylsiloxane, PCBs, cadmium nitrate, copper sulfate, nickel nitrate and zinc nitrate by river sediments was carried out by using either a flow-through system or a semi-static system. An equation is given to determine the material balance in the sediment compartment. The adsorption rate constants (K1), desorption rate constants (K2) and concentration factors (K1/K2) were calculated. For hydrophobic chemicals, the K1's were independent of water solubility, but the K2's were relatively related to water solubility. For both hydrophobic chemicals and heavy metals, the concentration factors per fraction organic carbon were similar to the soil sorption coefficients, expressed on a organic carbon basis. (Author's abstract)
W85-06432

TRANSPORT AND TRANSFORMATIONS OF ORGANIC CHEMICALS,
Jordan (Edward C.) Co., Inc., Portland, ME.
J. Dragun, A. C. Kuffner, and R. W. Schneiter.
Chemical Engineering, Vol. 91, No. 24, p 65-70, November, 26, 1984. 2 Fig, 1 Tab, 33 Ref.

Descriptors: *Path of pollutants, *Organic compounds, *Groundwater pollution, Fate of pollutants, Leaching, Landfills, Pipes, Spills, Seepage, Water pollution sources.

Chemicals can reach groundwater stores through five pathways: seepage from unlined lagoons and other surface impoundments; improper landfilling; improper surface and subsurface disposal; leaks in pipes, process equipment and storage tanks; and accidental spills. After establishing that a contaminant has been released to any of the above mentioned pathways, the next step is to determine its rate and direction of movement. Movement through the unsaturated zone, movement through the saturated zone, geology and lithology of aquifers, groundwater flow through aquifers, geologic and hydrologic investigations, the fate of chemicals in groundwater, adsorption, volatilization from soil, biodegradation, chemical degradation are each considered. (Baker-IVI)
W85-06451

CONTENT OF HEAVY METALS IN WATER AND IN CERTAIN AQUATIC PLANTS OF THE DANUBE AND DNIEPER MOUTH AREAS (SODERZHANIE TYAZHELYKH METALLOV V VODE I NEKOTORYKH VODNYKH RASTENIYAKH VST'EVYKH OBLASTEI DUNAYA I DNESTRA),
V. N. Kavetsky, A. I. Karnaukhov, and I. M. Palienko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 65-68, 1984. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Metals, *Natural waters, *Chromatography, *Water analysis, Mercury, Copper, Zinc, Lead, Aquatic plants,.

A chromatographic method is suggested for determining mercury, zinc, copper and lead in natural water bodies and in certain aquatic plants. Sensitivity in determining the substances is equal to 0.5, 0.5, 3 and 5 microg in a sample, respectively. (Author's abstract)
W85-06470

EVALUATION OF THE CONSUMED ORGANIC SUBSTANCE STOCK AND INTENSITY OF ITS DESTRUCTION IN THE KILIAN DELTA OF THE DANUBE (OTSENKA ZAPASA USVOYAEMOGO ORGANICHESKOGO VESHCHESTVA I INTENSIVNOSTI EGO DESTRUKTSII V VODE KILIISKOI DEL'TY DUNAYA),

For primary bibliographic entry see Field 2J.
W85-06482

CHLOROPHYLL A IN WATER OF LAKE BAIKAL (KHLOROFILL A V VODE OZ.BAIKAL),
O. M. Kozhova, V. N. Pautova, L. R. Izmestyeva, and I. K. Davydova.
Gidrobiologischeski Zhurnal, Vol. 20, No. 6, p 42-49, 1984. 7 Fig, 3 Tab, 8 Ref.

Descriptors: *Chlorophyll a, *Lake Baikal, *USSR, Spatial distribution, Eutrophication, Seasonal variation, Eutrophication, Melosira, Water depth.

The seasonal dynamics and spatial distribution of chlorophyll a were studied in Lake Baikal (USSR). During the course of a year, the chlorophyll a concentrations in 80% of cases do not exceed 1 mg/cu m. The highest values (up to 16 mg/cu m) are recorded during subglacial water blooms due to mass development of Melosira. In the whole lake area, only the Selenga shoal region is distinguished for the chlorophyll a content. Maximum concentrations are found in the upper 50 m layer of water. Below 50 m, the chlorophyll a concentrations are 4 to 10 times lower, and at the bottom, the concentrations are only 4 to 13% of those in the upper layer. (Moore-IVI)
W85-06483

DEPENDENCE OF THE RADIONUCLIDE ACCUMULATION LEVEL IN AQUATIC PLANTS ON ECOLOGICAL FACTORS (ZAVISIMOST' UROVNYA NAKOPLENIYA PADIONUKLIDOV V VODNYKH RASTENIYAKH OT EKOLOGICHESKIKH FAKTOROV),
D. P. Marchulenene, and P. F. Dushauskene-Duzh.
Gidrobiologischeski Zhurnal, Vol. 20, No. 6, p 67-73, 1984. 5 Tab, 11 Ref.

Descriptors: *Radioisotopes, *Aquatic plants, Seasonal variation, Calcium, Potassium, Pulp wastes, Industrial wastewater, DDT, EDTA, DTPA, Saliuity, Lead radioisotopes, *Strontium radioisotopes, Cesium radioisotopes, Cerium radioisotopes, Ruthenium radioisotopes.

Natural factors (including season, salinity, Ca(2+) and K(+) concentration in water) and anthropogenic factors (sewage from an integrated pulp and paper mill, DDT and complexions) were studied for their effect on biologic consumption of metal radionuclides by aquatic plants from lakes and reservoirs. An increase in salinity from 0.02 to 7 0/00 results in a decrease in Sr-90 and Cs-137 accumulation by aquatic plants, whereas absorption of Ce-144, Ru-106, and Pb-210 decreased less. Salinity has less effect on the accumulation of Sr-90 and Cs-137 than the variation in Ca and K ions does. Accumulation of radionuclides by aquatic plants is affected by pulp and paper mill wastewater as well as by DDT, EDTA and DTPA complexions. (Moore-IVI)
W85-06484

STUDY OF THE PH OF RAIN IN LAFAYETTE, LOUISIANA,
University of Southwestern Louisiana, Lafayette. Dept. of Chemistry.
R. D. Braun.
Louisiana Academy of Sciences, Vol. 47, p. 42-44, December, 1984. 2 Tab, 4 Ref.

Descriptors: *Acid rain, *Precipitation, *Louisiana, *Lafayette, Water pollution sources, Sampling, Precipitation chemistry, Air pollution.

This study was conducted to determine whether the rain in Lafayette was sufficiently acidic to be considered hazardous, to study data trends attributable to day or month, and to study trends attributable to rain depth. Rain samples were collected from 18 April 1983 to 24 April 1984 at three locations in Lafayette. During the study 241 samples were collected on 119 days. The mean pH for the year was 5.21. Samples collected on Wednesdays and Fridays had significantly lower pH values than samples collected on other days. Lafayette has no major industrial sources of air pollution. Greater air pollution on days of increased automobile traffic flow could partially explain this phenomenon. If acidic rainfall were due to air pollutants that were flushed from the air with the first portion of precipitation, then the pH would be expected to be lowest for rains of small depth. Since this is not the case, this theory can be discarded. (Baker-IVI)
W85-06489

BROMIDE-OXIDATION INTERACTIONS AND THM FORMATION: A LITERATURE REVIEW,
Capitol District Library Council for Reference and Research Resources, Troy, NY.
W. J. Cooper, R. G. Zika, and M. S. Steinhauer.
Journal of the American Water Works Association, Vol. 77, No. 4, p 116-121, April, 1985. 107 Ref.

Descriptors: *Trihalomethanes, *Bromides, *Chlorination, Water treatment, Water pollution sources, Drinking water, Monochloramine, Organic matter, Ammonia, Chemical reactions.

Research findings from 1946 to 1984 concerning the formation of trihalomethanes from chlorine-bromide, chlorine dioxide-bromide, and monochloramine-bromide are summarized. For chlorine-bromide, chlorine quantitatively oxidized bromide to hypobromous acid and hypobromite ion. In the presence of natural organic matter, waters containing Br(-) will form brominated THMs when chlorinated. Bromide, when present, tends to increase the concentration of THMs in chlorinated waters when compared with the concentration of THMs in similar waters if no bromide is present. The effect of solar-induced photochemical reaction on the formation of brominated THMs when natural waters containing bromide are chlorinated is not known. The quantitative effect of the variables on the formation and distribution of THMs has not been completely described. Excess ammonia may minimize THM formation. For chlorine dioxide-bromine, the former will not oxidize bromide to HOBr and OBr(-). The formation of THMs when chlorine dioxide is used is probably caused by slight hypochlorous acid and hypochlorite ion contamination. Monochloramine reacts with bromide to form mixed halamine; the rate of the reaction is affected by pH; the higher the pH, the slower the reaction. (Baker-IVI)
W85-06490

TRANSPORT OF IMMISCIBLE FLUIDS WITHIN AND BELOW THE UNSATURATED ZONE: A NUMERICAL MODEL,
GeoTrans, Inc., Herndon, VA.
C. R. Faust.
Water Resources Research, Vol. 21, No. 4, p 587-596, April, 1985. 12 Fig, 5 Tab, 16 Ref.

Descriptors: *Mathematical models, *Path of pollutants, *Unsaturated zone, Porous media, Groundwater pollution, Groundwater movement, Saturated zone, Soil water, Immiscibility.

A numerical model is developed that describes the simultaneous flow of water and a second immiscible fluid under saturated and unsaturated conditions in porous media. The governing equations are a simplified subset of the three-phase flow equations commonly used in petroleum reservoir simulation. The simplification is analogous to that used to derive the Richard's equation for flow of water in the unsaturated zone. The assumption that pressure gradients in the air phase are negligible leads to two partial differential equations. The proposed formulation is posed in terms of volumetric water saturation and fluid pressure in the immiscible fluid. The two-dimensional equations for flow in a vertical plane are approximated by finite differences. The fully implicit equations are solved by a direct matrix technique and Newton-Raphson iteration on nonlinear terms. The resulting numerical model is potentially applicable to many problems associated with immiscible contaminants in groundwater. Unfortunately, data such as relative permeabilities and capillary pressures for the types of fluids and porous materials present in hazardous waste sites are not readily available. As this type of data becomes available and field investigation techniques improve, applications of this type of model will become more practical. Examples are used to demonstrate the potential application of the model and the sensitivity of results to fluid properties. (Author's abstract)
W85-06513

GROUNDWATER CHEMISTRY CHANGE DUE TO TIDAL FLUCTUATIONS IN THE STONEHOUSE BREWERY WELL, PLYMOUTH, ENGLAND,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2F.
W85-06516

JUDICIAL RECOURSE AGAINST FOREIGN AIR POLLUTERS: A CASE STUDY OF ACID RAIN IN EUROPE,
Harvard Law School, Cambridge, MA.
For primary bibliographic entry see Field 6E.
W85-06529

HEAVY METALS IN THE DRINKING WATER FROM CISTERNS SUPPLYING SINGLE-FAMILY DWELLINGS,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W85-06545

RECENT SEDIMENTATION RATES AND 210PB FLUXES IN GEORGIAN BAY AND LAKE HURON,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 2J.
W85-06547

HEAVY METALS IN AQUATIC PLANTS, CLAMS, AND SEDIMENTS FROM THE CHESAPEAKE BAY, U.S.A. IMPLICATIONS FOR WATERFOWL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
R. T. Di Giulio, and P. F. Scanlon.
Science of the Total Environment, Vol. 41, No. 3, p 259-274, March, 1985. 5 Fig, 5 Tab. 35 Ref.

Descriptors: *Heavy metals, *Aquatic plants, *Chesapeake Bay, *Waterfowl, *Sediments, *Clams, Lead, Copper, Zinc, Macrophytes, Cadmium, Water pollution sources, Organic matter.

Benthos and sediments were collected from 21 locations in the Chesapeake Bay region. Both plants and clams were found in three of these. Concentrations of cadmium and lead appeared generally higher in aquatic macrophytes than in clams. Zinc concentrations, were generally higher in clams, while little difference was apparent in copper concentrations. Based on these findings, the change occurring in the food habitats of some Chesapeake Bay waterfowl away from submerged macrophytes and towards greater utilization of clams would not be expected to increase exposure to the highly toxic elements cadmium and lead. Highest concentrations of cadmium were generally observed in more carnivorous species than in more herbivorous species. Lead shot appears to be an important source of lead for Chesapeake Bay waterfowl, and more herbivorous species appear at greater risk of ingesting this shot. Highest lead, copper and zinc concentrations were observed in sediments from the Patapsco River, which is probably due to the proximity of Baltimore Harbor. Highest cadmium concentrations were noted in sediments in the Port Tobacco River, a tributary of the Potomac River. These observations were generally consistent with high concentrations of the respective metals in biota from these locations. Concentrations of the four metals in sediments were highly correlated to organic matter content. (Baker-IVI)
W85-06549

TRACE METAL CONTENT OF LIVE TISSUES OF HALIMIONE PORTULACOIDES FROM THE COASTAL AREAS OF THE SADO ESTUARY, PORTUGAL,
F. H. S. Reboredo.
International Journal of Environmental Studies, Vol. 24, No. 1, p 43-47, 1985. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Trace metals, *Plants, *Sado Estuary, *Portugal, Aluminum, Copper, Iron, Zinc, Estuaries, Fate of pollutants, Aluminum, Copper, Iron, Zinc.

Plant samples were collected in January 1982, during low tide from three points. Halimione portulacoides lives in the high zone of the marsh or bordering drainage channels. This area receives untreated domestic sewage from a populous city, Setubal, and an important input of residual elements due to the high agricultural and industrial activity around and upstream from Setubal. Live tissues of H. portulacoides from different sampling points have different degrees of Al, Cu, Fe and Zn accumulation. For Zn, two accumulating organs must be considered - roots and leaf. The highest levels of Al, Cu and Fe were always found in roots, while the lowest levels were always observed in stems. Copper and iron levels were highly correlated in all tissues, while for Al and Zn high correlations were noted between the leaf and the stem. (Baker-IVI)
W85-06558

INTERPRETATION OF LEACHING UNDER MULTIPLE FERTILIZER APPICATIONS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
D. A. Barry, C. W. Rose, P. G. Saffigna, and J.-Y. Parlange.
Journal of Soil Science, Vol. 36, No. 1, p 9-20, March, 1985. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Leaching, *Fertilizers, *Agricultural chemicals, *Soil water, Nitrates, Chloride, Groundwater, Irrigation, Permeability, Soil properties, Solute transport.

The ability of the solute transport model to partition the total measured fertilizer loss into that from each fertilizer application is demonstrated. The illustrate method can be used to aid the task of devising efficient and effective fertilizer strategies for a wide variety of soil, crop and environmental conditions. Simple theory is used which allows estimation of the mean depth of solute penetration from any sequence of infiltration and evapotranspiration events and of the apparent dispersion about this mean depth used as a Lagrangian coordinate system. This theory was used to analyze and interpret the time patterns of leachate concentrations of nitrate-nitrogen and chloride of a field lysimeter with a potato crop receiving four fertilizer applications and numerous inadvertent N and Cl application by irrigation with groundwater. The assumption of superposition of estimated solute concentrations was employed in the analysis, yielding results consistent with the data. The analysis has quantified the leaching loss from each fertilizer application. (Baker-IVI)
W85-06564

CEGB LEFT OUT IN THE RAIN,
F. Pearce.
New Scientist, Vol. 105, No. 1445, p 10-11, 28 February, 1985. 3 Fig.

Descriptors: *Great Britain, *Acid rain, Lakes, Europe, Fate of pollution, Water pollution effects, Water pollution sources, Powerplants, Air pollution.

The Central Electricity Generating Board (CEGB), Great Britain's biggest air polluter, is at the center of the controversy over acid rain. The case against Great Britain for causing acid rain is strongest over the acidification of freshwater lakes and rivers in Scandinavia and, at home, in Scotland, the Lake District and Wales. The central issue of the whole debate about acid rain concerns linearity: whether the amount of acid emitted into the atmosphere over Europe is in any way linked to the amount of acid that falls on Europe. Some scientists argue that European emissions of sulfur increased by about 35% between 1963 and 1975, yet the wet deposition fo sulfur was actually observed to have decreased at many sites. Over this same period, not one out of 120 EACN (European Air Chemistry Network) sites exhibited a significant increase in precipitation acidity. Other scientists disagree with these findings. The science of acid rain's corrosive effect on buildings is also advancing. All factors of the acid rain issue appear to have become involved in political debates with little real progress in sight. (Baker-IVI)
W85-06569

REVERSIBLE AND RESISTANT COMPONENTS OF HEXACHLOROCYCLOHEXANE (LINDANE) SORPTION TO NEW JERSEY COASTAL PLAIN AQUIFER SOLIDS,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
C. G. Uchrin, and J. Katz.
Journal of Environmental Sciences and Health, Vol. A20, No. 2, p 205-218, February, 1985. 10 Fig, 2 Tab, 10 Ref.

Descriptors: *Adsorption, *Desorption, *Lindane, *Soils, *New Jersey, Pesticides, Fate of pollutants, Aquifers, Chlorinated hydrocarbons, Groundwater pollution.

Knowledge of a pollutant's sorptive characteristics in a particular adsorber system is critical to prediction of its transport and potential fate in groundwater as well as surface water systems. The sorptive characteristics of lindane to representative soil samples from New Jersey's coastal plain aquifers was studied. Two soils, representative of different aquifer systems were used in this study. The soil from the Cohansey aquifer is a sand containing a 4.4% organic fraction. The soil from the Potomac-Raritan-Magothy aquifer is a sandy loam with a 2.2% organic fraction. Equilibrium studies exhibited linear adsorption isotherms with an association constant of 0.013 l/g for the Cohansey solids and 0.011 l/g for the Potomac-Raritan-Magothy solids. Desorption data indicated a pronounced hysteresis, indicating that the sorption processes for these systems were not completely reversible. Both Freundlich (indicating complete desorption) and linear (indicating incomplete desorption) isotherms were fitted to the data. The Freundlich isotherm must, by definition, pass through the origin, thus implying that the desorption process can be driven to completion. Examination of the data does not lead conclusively to this as it appears that complete desorption is being resisted. (Moore-IVI)
W85-06600

ROAD SALT CONTAMINATES WELL, CAUSES HEALTH HAZARD,
D. Scheel.
Journal of Environmental Health, Vol. 47, No. 4, p 202-203, January/February, 1985. 11 Ref.

Descriptors: *Water pollution sources, *Groundwater pollution, *Wells, *Deicers, *Salts, Highways, Runoff, Leaching, Drinking water, Chlorides, Bacteria, Water quality control, Water pollution effects, Corrosion.

Water pollution occurring from runoff and leaching of salt from highways into the soil presents health problems. An incident of groundwater contaminant resulting from improper storage of a sand-salt mixture for use in road deicing in New York State is reported. In the fall of 1979, sand salt mounds were dumped for storage directly on top of a 100 ft deep driven well shaft cover. In November 1980 a resident who lived near the garage where the material was stored became ill from complications of kidney disease which was traced to high levels of chloride and bacteria in the water from their privately owned driven well. The same family operates a pet grooming business on the premises and houses numerous large and small animals. Before discovery of the well water contamination, many of the small animals died. The unusually high alkalinity of the water caused by the high salt content has caused corrosion of their plumbing, problems with the hot water heater, dishwasher and faucets, and deterioration of aluminum and stainless steel cooking utensils. In addition, the property has been devalued by 40% since the well has become contaminated, and there is no safe water supply for domestic use. Through action by the State Department of Environmental Conservation, the town was required to strip the upper layer of soil, replace it with gravel, dig a drainage ditch for the property, and remove the sand-salt piles. The work was begun in April 1981. The salt is now stored indoors. In a survey of other area wells, 15 others had high levels of salt. (Baker-IVI)
W85-06611

SWINE LAGOON EFFLUENT APPLIED TO 'COASTAL' BERMUDAGRASS: III. IRRIGATION AND RAINFALL RUNOFF,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W85-06613

EFFECT OF SOIL PROCESSES ON THE ACIDIFICATION OF WATER BY ACID DEPOSITION,
Colorado State Univ., Fort Collins.
J. O. Reuss, and D. W. Johnson.
Journal of Environmental Quality, Vol. 14, No. 1, p 26-31, January/March, 1985. 4 Fig, 2 Tab, 22 Ref. DOE contract DE-AC05-840R21400.

Descriptors: *Acid deposition, *Soil chemistry, *Acidification, Path of pollutants, Hydrogen ion concentration, Alkalinity, Carbon dioxide, Degassing, Soil solution, Acid rain, Sulfuric acid, Ion exchange.

A mechanism by which surface waters may be acidified by atmospheric deposition through soil-mediated processes is identified. Chemical equilibrium models show that for soils with low to moderately low exchangeable bases (15% Ca(2+) saturation), the soil solution pH is only slightly affected by CO2 partial pressures over the range likely to be found in soils (1-5% CO2), but the alkalinity of the soil solution increases rapidly with increasing CO2 partial pressure. Solutions that are not in contact with the soil's cation exchange complex maintain alkalinity independently of CO2 partial pressure. If alkalinity is positive, the pH in such solutions rapidly increases in response to decreasing CO2 pressure. Waters having positive alkalinity will undergo a rapid rise in pH when released from the soil due to CO2 degassing, while waters with negative alkalinity (net acidity) remain acid when degassed. The effect on the soil of precipitation containing H2SO4 is to increase the SO4(2-) concentration. In acid soils, ion exchange reactions that take place in response to increasing SO4(2-) from 25 to 250 micro mol (e-) /L can be expected to depress soil solution pH by 0.2 to 0.4 units. This depression is sufficient to cause a switch from positive to negative alkalinity in many soil solutions and when water with negative alkalinity are released from the soil they remain acid when degassed. This could account for a change in pH of surface waters from 6.25 to 5.0 or less, while the change in soil solution pH would be < 0.3 units. This mechanism does not depend on soil acidification in the sense of a reduction in base saturation. The effects are instantaneous and completely reversible if no anion adsorption occurs, but will be delayed and prolonged by anion adsorption-desorption processes. (Moore-IVI)
W85-06614

SALINE COOLING TOWER WATER FOR IRRIGATION IN MINNESOTA: II. DRAINAGE WATER COMPOSITION, LEACHING FRACTION, AND EFFECT ON AQUIFER QUALITY,
Montana Agricultural Experiment Station, Huntley, MT. Southern Agricultural Research Center.
For primary bibliographic entry see Field 3C.
W85-06616

PERSISTENCE AND FATE OF 2,4-D BUTOXYETHANOL ESTER IN ARTIFICIAL PONDS,
Ontario Ministry of the Environment, Toronto.
B. C. Birmingham, and B. Colman.

Journal of Environmental Quality, Vol. 14, No. 1, p 100-104, January/March, 1985. 2 Fig, 2 Tab, 41 Ref.

Descriptors: *Herbicides, *Fate of pollutants, *2,4-D Butoxyethanol ester, Aquatic weed control, Water temperature, Dichlorophenoxyacetic acid, Watermilfoil, Sediments, Aquatic plants.

A granular formulation of the butoxyethanol ester of 2,4-dichlorophenoxyacetic acid (2,4-D) was applied at a rate of 23 kg a.i./ha to outdoor, artificial, polythene-lined ponds infested with Eurasian watermilfoil (Myriophyllum spicatum L.). Water temperature dropped from 25 C at time of treatment to 0 C after 56 d and the ponds were frozen over for the rest of the study. Samples of plant material, pond water, and sediment were taken over a 180-d period, extracted, and analyzed by gas chromatography to determine residue concentrations of ester and 2,4-D. Ester levels in water were low and dropped to < 1.0 micro-g/L within 15 d. Ester concentration in sediment 7 d post application was 1.7 micro-g/g dry wt, but dropped to 0.1 micro-g/g dry wt after 42 d. 2,4-Dichlorophenoxyacetic acid residues in water declined to 1.0 mg/L after 85 d and to 0.2 mg/L after 178 d. Residues in plant material dropped to 10 micro-g/g dry wt after 70 d; sediment residues were negligible after 50 d. Residues of 2,4-dichlorophenol or 2,4-dichloroanisole were not detected in any samples. Despite the low temperature prevailing in the latter half of the study, a relatively rapid rate of 2,4-D breakdown was maintained both in pond water and sediment. (Author's abstract)
W85-06621

EFFECTS OF ANAEROBICALLY DIGESTED POULTRY MANURE ON SOIL PHOSPHORUS ADSORPTION AND EXTRACTABILITY,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5D.
W85-06622

ADSORPTION-DESORPTION KINETICS OF ATRAZINE AND LINURON IN FRESHWATER-SEDIMENT AQUEOUS SLURRIES,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. D. Wauchope, and R. S. Myers.
Journal of Environmental Quality, Vol. 14, No. 1, p 132-136, January/March, 1985. 3 Fig, 3 Tab, 19 Ref.

Descriptors: *Atrazine, *Linuron, *Adsorption, *Desorption, *Sediments, Mixing, Fate of pollutants, Runoff, Solute transport, Equilibrium, Chemical kinetics, Organic compounds.

To understand how synthetic organic chemicals, specifically pesticides, behave in runoff streams when those streams combine in a watershed, knowledge is needed on how the mixing process affects the partitioning of the solute between sediment and water phases. A fast sampling and filtration technique was used to determine the rapidity with which the herbicides atrazine and linuron are adsorbed or desorbed in sediment-water mixtures. When aqueous solutions of the herbicides were exposed to wet sediment, or when wet sediments containing the adsorbed herbicides were exposed to water, the resulting adsorption or desorption, respectively, was initially very fast, approaching 75% of equilibrium values within 3 to 6 min. Herbicide adsorption on the sediments was completely reversible after 2 h of adsorption time: kinetic parameters obtained from a statistical fit of a sequential-equilibria model to the adsorption data also fit desorption data. It appears that in the well-mixed slurries of sediments that occur in runoff and mixing streams, adsorption and desorption equilibria of typical nonionic organic herbicides can respond rapidly and reversibly to changes in the mixture, nearing a new equilibrium in minutes. This may not apply to chemicals that have had longer times to react with soil surfaces. To a first approximation, hydrological chemical transport models of well-mixed combining streams may assume reequilibrium occurs instantly with a new sediment-water partitioning based on the sorptive properties of the combined sediment. (Moore-IVI)
W85-06624

ELEMENT ACCUMULATION AND RELEASE BY MACROPHYTES IN A WETLAND STREAM,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 2H.
W85-06625

ADSORPTION AND DESORPTION OF HEXAVALENT CHROMIUM IN AN ALLUVIAL AQUIFER NEAR TELLURIDE, COLORADO,
Geological Survey, Denver, CO.
K. G. Stollenwerk, and D. B. Grove.
Journal of Environmental Quality, Vol. 14, No. 1, p 150-155, January/March, 1985. 8 Fig, 5 Tab, 23 Ref.

Descriptors: *Chromium, *Adsorption, *Desorption, *Alluvial aquifers, *Telluride, *Colorado, Drinking water, Groundwater pollution, Iron oxides, Chemical kinetics.

A laboratory investigation of reactions between hexavalent chromium (Cr(VI)) and alluvium was conducted to evaluate reactions of Cr(VI) contaminating an alluvial aquifer near Telluride, CO and to determine the mechanisms responsible for these reactions. Uncontaminated alluvium and groundwater (spiked with CrO4(2-)) from the study site were used in batch and column experiments. Results of these experiments show that Cr(VI) was adsorbed by the alluvium. Distribution coefficients from batch experiments ranged from 52 L/kg at an equilibrium CrO4(2)-concentration of 0.4 micro-mol/L to 1.7 L/kg at an equilibrium concentration of 1400 micro-mol/L. The zero point of charge for alluvium was approximately 8.3, and the alluvium had a positive net charge at the groundwater pH of 6.8. Visual and chemical evidence indicated that Fe oxide and hydroxide coatings on the alluvial particles principally were responsible for the adsorption of Cr(VI). During column experiments, Cr(VI) initially was desorbed easily from the alluvium by Cr-free groundwater; however, the rate of desorption decreased rapidly, and > 60 pore volumes of groundwater were required to decrease the effluent concentration of Cr(VI) to 3 micro-mol/L (drinking water standard for concentration of Cr(VI) = 1 micro-mol/L). The quantity of Cr(VI) adsorbed varied with the type and concentration of other anions in solution. (Author's abstract)
W85-06626

PACKAGED BOILERS: THEIR ROLE IN WATER POLLUTION,
Cranfield Inst. of Tech. (England). School of Water Sciences.
G. S. Solt.
Effluent and Water Treatment Journal, Vol. 25, No. 1, p 14-18, January, 1985.

Descriptors: *Boiler water, *Water pollution sources, *Boilers, *Wastewater management, Water quality control, Water treatment, Blowdown.

Modern society relies on large numbers of small boilers, each of which discharges heat, inorganic and organic materials to the aqueous environment. While each boiler alone discharges small amounts of these, their combined effect may be significant. Water management in packaged boiler systems tends to be inefficient. Improvements aimed at reducing the costs of boiler operation would bring additional benefit by reducing the load of inorganic wastes added to the environment. The main objective of boiler water management is to control the quality of the boiler water. As hardness must be absent from the feed, all makeup water must be treated, normally by ion exchange. The cheapest and commonest method is base exchange softening. Internal treatment is a complex science which includes the dosing of sodium hydroxide and/or sodium carbonate to control the pH and alkalinity, phosphates to suppress scaling and create manageable sludges instead, and a variety of organic materials, some volatile, some not. Oxygen must be removed from the feed water by thermal deaeration. Wastes are discharged from boiler installations at two points - the blowdown, and the effluent from the external water treatment plant. The overall waste load from a boiler system depends on the steam rating of the boiler, the proportions of condensate recovered, and of boiler water blowndown, and on the type of external treatment used. Individual boilers will differ widely in their effect on the environment. An estimate of pollutant load from a boiler is obtained and compared with actual levels found in an industrialized river system. (Baker-IVI)
W85-06628

ESTIMATING THE EFFECTIVENESS OF VEGETATED FLOODPLAINS/WETLANDS AS NITRATE-NITRITE AND ORTHOPHOSPHORUS FILTERS,
Agricultural Research Service, Fort Pierce, FL. Southeast Watershed Research Lab.
P. Yates, and J. M. Sheridan.
Agriculture, Ecosystems and Environment, Vol. 6, No. 3, p 303-314, May, 1983. 2 Fig, 3 Tab, 12 Ref.

Descriptors: *Floodplains, *Wetlands, *Nitrates, *Nitrites, *Orthophosphorus, Forest watersheds, Agricultural watersheds, Vegetation, Water quality, Nonpoint pollution sources, Fate of pollutants, Dilution.

The role of vegetated floodplains/wetlands on the stream water quality of agroecosystems in the Coastal Plain region of the southeastern United States is reported. Water-borne nitrate plus nitrite nitrogen budgets and orthophosphate phosphorus budgets from a cropped agricultural area were compared with those of a watershed with alluvial forests below the cropped areas. Analyses were made to determine if observed differences in nutrient concentrations and loads were the result of dilution of cropped area runoff by flows from noncropped areas. Reductions in the observed levels of nitrate plus nitrite nitrogen and orthophosphate phosphorus between upland cropped areas and watershed outlets exceed reductions that would be caused by dilution effects. Significant portions of the observed nutrients leaving cropped areas were retained, utilized and/or transformed in the vegetated floodplains/wetlands characteristic of these Coastal Plain watersheds. (Author's abstract)
W85-06634

SOLUBLE PHOSPHORUS RELEASE FROM ORGANIC SOILS,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy.
Agriculture, Ecosystems and Environment, Vol. 9, No. 3, p 373-382, July, 1983. 3 Fig, 4 Tab, 14 Ref.

Descriptors: *Organic soils, *Phosphorus, *Drainage water, *Florida, Flooding, Agronomic practice, Soil organic matter, Decomposition, Water pollution sources, Soil chemistry, Soil temperature.

Florida has approximately 1.5 million ha of organic soils, formed by the decay of wetland plants. During the summer months when crops are not planted, these soils are flooded as a management practice to control weeds and pests, and reduce soil subsidence. Following flooding they are drained, and drainage water is either pumped into recycle reservoirs or into adjacent lakes. Soluble P release during soil organic matter decomposition was measured under fluctuating seasonal temperatures in natural soil profiles obtained from seven locations in central and south Florida. Soil columns were flooded for 25 days in the months of July and August to simulate normal agronomic practice. The amounts of P released into effluent from Florida's organic soils were in the range of 2.9-26.2 micro-g P/cu cm of soil per year (16-168 kg P/ha/year). This represents 2.2-20% of the total soil P for central Florida organic soils and 0.75-1.1% of total soil P for south Florida organic soils. Soluble ortho-P accounted for about 70-89% of total effluent P for central Florida organic soils and 54-57% of effluent P for south Florida organic soils. Estimated soil P mineralization during organic matter decomposition was about 38-185 kg P/

ha/year for central Florida organic soils and 16-23 kg P/ha/year for south Florida organic soils. Seasonal temperature fluctuations had minimal influence on the P release into effluent. Compared with drained conditions, flooding the organic soils increased P release into drainage effluent by about 4-8 times, resulting in P loads to adjacent bodies of water. (Moore-IVI)
W85-06635

DETECTION OF TOXIC INHIBITION OF BIOCHEMICAL DEGRADATION IN RIVER WATER (NACHWEIS TOXISCHER HEMMUNGEN DES BIOCHEMISCHEN ABBAUS IN FLUSSWASSER),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
D. Spott.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 11-16, 1983. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Toxicity, *Biodegradation, *Bacteria, *Fate of pollutants, Biological oxygen demand, Organic compounds, Peptone.

A technique was developed for determining the inhibition by toxic substances of the biochemical decomposition of organic substances in surface waters. Since the aim is to describe as accurately as possible the processes occurring in the water and not to test individual substances for toxic properties, experimental conditions should approximate natural river conditions. The experimental organisms should be bacteria taken from the river itself and should be adapted to a certain extent to wastewater components present in the river. The proposed procedure is based on Viehl's BOD analysis which includes Winkler's method; peptone is used as the check substrate. Three experimental conditions are used: (a) river water, undiluted and without additives; (b) river water with 10 mg/l peptone; (c) standard BOD dilution water with 10 mg/l peptone and innoculation with river bacteria (control). Innoculation material is obtained by centrifugation after the river water has been through a plankton sieve. Graphic analysis of BOD for (a), (b), and (c), showed a steady, straight-line increase of BOD with time for all three conditions with (c), (a), (b), in ascending order and the lines diverging steadily; an area of toxic inhibition was shown between the line for (b) and one for (a) + (c). An arithmetic formula is used to evaluate individual degradation times: Inhibition % = 100 - (BOD(b) x 100)/(BOD(a) + BOD(c)). Both 2- and 5-day incubation times should be studied, at least for preliminary investigation, so that any additional, unwanted adaptation of bacteria during the experiment may be detected. Results of the method using water from different sources are given under unfavorable hydrological conditions and with extremely diluted wastewater inflows: after 2-day incubation, inhibition was 6-20% for one source and 10-31% for the other. (Author's abstract)
W85-06649

RELATIONSHIP OF WATER VOLUME AND WATER QUALITY PARAMETERS (ZUM ZUSAMMENHANG VON PARAMETERN DER WASSERMENGEN UND WASSERBESCHAFFENHEIT),
Forschungszentrum fuer Wassertechnik, Dresden (German D.R.).
U. Friedrich, U. Grunewald, and G. Wernecke.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 2, p 199-213, 1983. 4 Fig, 5 Tab, 6 Ref.

Descriptors: *Water quality, *Water supply, *Elbe, *Germany (Democratic Republic), Precipitation, Chemical oxygen demand, Nitrates, Suspended solids, Phosphates, Flow discharge, Hydrology.

The water quality criteria COD-Mn, NO3(-), suspended solids, and phosphates measured at two stations on the river Elbe in the Dresden section as well as an inflow gauge at a drinking water reservoir in the Eastern Ore Mountains were used to investigate correlative connections with hydrological and meteorological quantities. Statistical connections between matter-balance and water-balance components were recorded on the basis of regression statements. The large number of the factors to be observed in the development of process-describing matter discharge models is determined by the large number of causative or influencing quantities. With respect to continuing investigations, it is recommended that the dynamic character of precipitation and the influence of vegetation should be taken into account more exactly, especially in the case of substance components carried away from areas, such as suspended solids, nitrate, and o-phosphate. (Author's abstract)
W85-06662

TRIHALOMETHANES IN GROUNDWATER SYSTEMS,
Howard Univ., Washington, DC. School of Civil Engineering.
M. M. Varma, A. Balram, and H. M. Katz.
Journal of Environmental Systems, Vol. 14, No. 2, p 115-125, 1984-85. 3 Fig, 5 Tab, 7 Ref. EPA grant R-805689-02.

Descriptors: *Trihalomethanes, *Groundwater pollution, *Water treatment, Hydrogen ion concentration, Chloroform, Chlorination, Water pollution sources, Monitoring, Public health, Chemical treatment.

The formation of trihalomethanes (THMs) in various groundwater supply systems in the State of Maryland was studied. THM formation in water is associated with the interaction of aqueous chlorine and certain precursors. Samples of both raw and finished water were collected and analyzed for THMs and for THM formation potential at ambient pH and at pH 9. In raw water samples, the only THM detected was chloroform, and the highest concentration was 2.5 micro g/l. In finished water samples, chloroform concentrations were somewhat higher and no other species were detected, except for one supply where the chloroform concentration was 24.8 micro g/l and total THMs were 103.5 micro g/l, the difference being brominated compounds. Significant amounts of brominated compounds were found in only one other supply, but total THM's were relatively low. The results of THM formation potential generally followed the same pattern, and showed a slight increase in formation potential at higher pH. Certain groundwaters may contain THM precursors; therefore, routine monitoring is necessary to safeguard the health of the people. Monitoring is more important for small towns which serve less than 10,000 people. THM formation potential was reduced in the plants where chemical precipitation was used. (Moore-IVI)
W85-06696

TRANSPORT OF ORGANIC CONTAMINANTS IN GROUNDWATER,
Stanford Univ., CA. Dept. of Civil Engineering.
D. Mackay, P. V. Roberts, and J. A. Cherry.
Environmental Science and Technology, Vol. 19, No. 5, p 384-392, May, 1985. 6 Fig, 33 Ref.

Descriptors: *Groundwater pollution, *Transport, *Fate of pollutants, Aquifers, Gravel aquifers, Aquifer characteristics, Groundwater, Monitoring, Water quality control, Organic compounds, Advection, Dispersion, Temperature effects, Acidity, Sorption, Retardation.

The state of understanding of the physical, chemical, and biological processes that are thought to affect organic contaminants in the saturated (groundwater) zone are reviewed. The vadose zone is not discussed in any detail. Because many aquifers used for water supply comprise horizontal geological units of sand and gravel, the discussion is limited to horizontal flow in such aquifers. Current understanding of the processes that are important to the saturated zone help to illustrate the conceptual complexities of organic contaminant transport and distribution in the groundwater zone. Some of the implications of groundwater contamination are presented. Transport processes considered include advection, dispersion, sorption and retardation. The chemical or biological transformation of organic contaminants into other compounds is considered along with factors which influence these changes such as temperature and acidity. The transport and distribution of a contaminant is different when the source is a continuous one as opposed to a one-time release or to pulse sources. Differences also occur when considering a low-density vs a high-density organic liquid. Monitoring of complex sources, predicting contaminant migration, and evaluating remedial action are also considered. (Baker-IVI)
W85-06704

SEDIMENT AND NUTRIENT EXPORT IN RUNOFF FROM BURNED AND HARVESTED PINE WATERSHEDS IN THE SOUTH CAROLINA PIEDMONT,
Clemson Univ., SC. Dept. of Forestry.
D. H. Van Lear, J. E. Douglass, S. K. Cox, and M. K. Augspurger.
Journal of Environmental Quality, Vol. 14, No. 2, p 169-174, April/June, 1985. 1 Fig, 5 Tab, 16 Ref.

Descriptors: *Sediments, *Nutrients, *Runoff, *Pine trees, *Forest watersheds, *South Carolina, *Forest Fires, Erosion, Nonpoint pollution sources, Clear-cutting, Forest management, Water pollution sources, Path of pollutants.

Soil and nutrient export in ephemeral flow were studied over a 3-yr period following clearcutting three loblolly pine (Pinus taeda L.) watersheds (0.60-1.24 ha). Two preharvest, low-intensity prescribed fires had no effect on flow or water quality. Harvesting after the third prescribed fire significantly increased sediment concentration and export, but increases were minor compared with sediment export reported for mechanical site preparation. Nutrient concentrations varied among watershed locations because of differences in surface soil depth, but were generally unaffected by harvest. Because harvest increased runoff, nutrient export (concentration x flow) was generally increased. Results of this study show that loblolly pine stands in the erosive Piedmont physiographic region can be harvested following a series of low-intensity prescribed fires with minimal soil loss or degradation of water quality. (Author's abstract)
W85-06714

SALT ACCUMULATION IN THE RIVERS OF NORTH DAKOTA,
North Dakota State Univ., Fargo. Dept. of Soil Science.
A. Maianu.
Journal of Environmental Quality, Vol. 14, No. 2, p 211-217, April/June, 1985. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Salinity, *Rivers, *North Dakota, *Conductivity, Sodium adsorption ratio, Salt, Chemical characteristics, Geochemistry.

Chemical determination on over 9000 water samples collected from 83 rivers and analyzed by the U.S. Geological Survey between 1949 and 1982 were used to establish the patterns of salt accumulation in North Dakota rivers. The concentrations of the principal anions, cations, and sodium adsorption ratio (SAR) were related with the total salinity (electrical conductivity, EC) of each water sample. Some patterns of salt accumulation were observed: first, according to the anions that accumulate as a continuum with increases in total salinity; and secondly, by the rate of anion accumulation. Taking into consideration these two factors, eight groups of river waters were established. Thirdly, the change of the ratios between the anions with increases in total salinity creates a succession of stages of salt accumulation. Each stage corresponds to the change of the river water chemical composition between particular total salinity limits. These changes are specific for each group of rivers depending on the topographic and geologic conditions that prevail in the drainage basin of the rivers. Based on these three factors, a genetic classification of river waters was derived, which consists in ranking the waters in three categories: classes, groups, and stages of salt accumulation. (Author's abstract)
W85-06718

AFLATOXIN MOVEMENT IN SOIL,
Maryland Univ., College Park. Dept. of Agrono-

my.
B. S. Goldberg, and J. S. Angle.
Journal of Environmental Quality, Vol. 14, No. 2, p 224-228, April/June, 1985. 4 Fig, 2 Tab, 31 Ref.

Descriptors: *Aflatoxin, *Groundwater contamination, *Soil properties, Fate of pollutants, Adsorption, Mycotoxins, Leaching.

Crops contaminated with > 20 microg/kg aflatoxin cannot be transported across state lines. Contaminated preharvest crops are often disposed of by plowing the crop into the soil, thereby creating the potential for aflatoxin contamination of groundwater. The objective of this study was thus to determine the leaching and adsorption potential of aflatoxin in soils. Leaching and adsorption studies were conducted with a silt loam, clay loam, sandy loam, and silty clay loam soil. Soil columns were utilized in the leaching experiment. The length of the column and the volume of soil used were 30.54 cm and 1234 cu cm, respectively. A total of 2.5 mg aflatoxin B sub 1 was applied to the soil surface and the column was leached with 1 L of water under saturated conditions for 24 h. The results demonstrate that aflatoxin B sub 1 or its derivatives, aflatoxin B sub 2 and G sub 2, were retained within the upper 20 cm of all soil types. Between 80 and 92% of the total amount of aflatoxin applied was retained in the upper 2.5 cm of the soil columns. No aflatoxin was found in the leachate from any of the soils. Freundlichs isotherm was used to establish adsorption coefficients for the soils by the slurry technique. The concentrations of aflatoxin used to establish the constants were 0.1, 1.0, 5.0, and 10 mg/L. The resulting adsorption coefficients were 238, 76, 46, and 17 mg/kg for the silty clay loam, silt loam, clay loam, and sandy loam, respectively. As a result of the two experiments, aflatoxin contamination of groundwater would not be expected to occur unless the soils were extremely sandy or shallow. (Author's abstract)
W85-06719

MOBILITY AND PERSISTENCE OF HEXAZINONE IN A FOREST WATERSHED,
Battelle-Northwest, Richland, WA.
D. C. Bouchard, T. L. Lavy, and E. R. Lawson.
Journal of Environmental Quality, Vol. 14, No. 2, p 229-233, April/June, 1985. 7 Fig, 2 Tab, 21 Ref.

Descriptors: *Hexazinone, *Forest watersheds, *Path of pollutants, *Herbicides, Pesticides, Forest management, Oak trees, Leaves.

The concentration of hexazinone (3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione) in soil, water, and plant tissue was monitored following hexazinone application (2.0 kg a.i./ha) to an 11.5-ha watershed in northwestern Arkansas. The hexazinone concentration in the top 10 cm of soil on the watershed decreased to approximately 10% of the initial concentration in 42 d. Hexazinone dissipation rate on the watershed was more rapid than could be accounted for solely by degradation. Leaching of hexazinone to lower soil depths probably was important to hexazinone dissipation. Hexazinone degradation in soil incubated at 10 and 30 C followed first-order kinetics and had a half-life of 77 d at 30 C. Hexazinone was stable in incubated stream water requiring several years for 50% disappearance of the compound at 30 C. The maximum hexazinone concentration in the stream that drained the watershed was 14 micro g/L, and hexazinone residues (< 3 micro g/L) were detected in stream discharge over 1 yr after application. The amount of hexazinone transported from the watershed in stream discharge represented 2.0 to 3.0% of the amount of initially applied. Analyses of oak foliage and leaf litter collected from the forest floor indicated that < 0.10% of the hexazinone applied was returned to the forest floor in leaf deposition. (Author's abstract)
W85-06720

REACTION OF FERTILIZER AND LIQUID MANURE PHOSPHORUS WITH SOIL AGGREGATES AND SEDIMENT PHOSPHORUS ENRICHMENT,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
For primary bibliographic entry see Field 5E.
W85-06722

LEACHING OF NITROGEN, PHOSPHORUS, AND ORGANIC CARBON FROM WHEAT STRAW RESIDUES: I. RAINFALL INTENSITY,
J. D. Schreiber, and L. L. McDowell.
Journal of Environmental Quality, Vol. 14, No. 2, p 251-256, April/June, 1985. 4 Fig, 8 Tab, 16 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Organic carbon, *Wheat straw, *Straw, *Rainfall intensity, *Agricultural runoff, Leachate, Nutrients, Crop residues, Nutrient cycling, Transport, Water quality, Source of pollutants, Runoff.

Knowledge of nutrients leached from crop residues will aid in understanding nutrient cycling in agricultural systems and in the development of small watershed chemical transport models. Using a multiple-intensity rainfall simulator, wheat straw residue (Triticum aestivum L.) was subjected to 25.4 mm simulated rainfall at intensities of 7, 12, 25, 53, and 105 mm/h. The wheat straw loading rate was 4500 kg/ha. Runoff was sampled as a function of time and analyzed for PO4(-3)-P, NH4(+)-N, NO3-N, and organic carbon (OC). Except for NO3-N, nutrient concentrations and losses were greater at the lower rainfall intensities. At each intensity, PO4(-3)-P, NH4(+)-N, and OC concentration in runoff from the wheat straw increased rapidly to maximum values and then decreased with time. After maximum nutrient concentrations were reached, a power function, Y = a(X to the b power), best described the relationship of nutrient concentrations with time, whereas a hyperbolic equation of the form Y = 1/(a + bX) best described the relationship of nutrient concentrations with runoff. The quantity (kg/ha) of nutrients leached from the wheat straw followed the order C > P > N as (NH4(+)-N + NO3-N). Amounts of N as (NH4(+)-N + NO3-N) and C leached from the wheat straw were < or = 1% of the nutrient content compared with 80 to 140 g/kg for P. The variability in both the leachability and nutrient content of crop residues from different sources will be important factors in the development of crop residue leaching models. (Author's abstract)
W85-06723

LEACHING OF NITROGEN, PHOSPHORUS, AND ORGANIC CARBON FROM WHEAT STRAW RESIDUES: II. LOADING RATE,
J. D. Schreiber.
Journal of Environmental Quality, Vol. 14, No. 2, p 256-260, April/June, 1985. 5 Fig, 4 Tab, 12 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Organic carbon, *Wheat straw, *Straw, *Rainfall intensity, *Agricultural runoff, Leachate, Nutrients, Crop residues, Nutrient cycling, Transport, Water quality, Source of pollutants, Runoff.

Using a rainfall simulator, wheat straw residue (Triticum aestivum L.) in 1.0-sq m pans was subjected to simulated rainfall. Runoff from the wheat residue was sampled as a function of time and analyzed for PO4(3-)-P, NH4(+)-N, NO3-N, and organic carbon (OC). Rainfall at 25 mm/h was applied for 1 h to five residue weights equivalent to field loading rates of 2200, 4500, 6700, 9000, and 11,200 kg/ha. As loading rates increased from 2200 to 9000 kg/ha, both concentrations and losses of PO4(3)-P, NH4(+)-N, and OC increased, whereas those of NO3-N decreased. During individual runoff events at all loading rates, PO4(3)-P, NH4(+)-N, and OC concentrations increased relatively rapidly to maximum concentration in runoff and then decreased during the remainder of the 1-h runoff event. The relationship of nutrient concentrations with time were described by a power function Y = aXb and to runoff by a hyperbolic equation of the form Y = 1/(a + bX). The quantity (kg/ha) of nutrients leached from the wheat residue followed the order C > P > N. For all loading rates, percentage N (NH4(+)-N + NO3-N) and C leached from the wheat residue was < 10 g/kg, compared with 240 to 430 g/kg for P. (Author's abstract)
W85-06724

LONG-TERM PHOSPHORUS SORPTION IN A BRUNISOL IN RESPONSE TO DOSED-EFFLUENT LOADING,
British Columbia Ministry of Environment, Victoria.
For primary bibliographic entry see Field 5E.
W85-06726

BIOACCUMULATION AND TOXICITY OF COPPER AS AFFECTED BY INTERACTIONS BETWEEN HUMIC ACID AND WATER HARDNESS,
Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner.
Water Research, Vol. 19, No. 4, p 449-455, 1985. 6 Fig, 3 Tab, 14 Ref.

Descriptors: *Water pollution effects, *Copper, *Toxicity, *Daphnia, Humic acids, Hardness, Water properties, Physical properties, Bioaccumulation, Crustaceans.

Using Daphnia pulex and D. magna as models, the interactive effects of humic acid (HA) and water hardness on the acute and chronic toxicity and bioaccumulation of copper were investigated. In the absence of HA, an increase in water hardness from 58 to 115 mg/l had no significant effect on the LC50 for copper. In hard water (230 mg/l) the LC50 was significantly lower than in medium water. Humic acid significantly reduced the acute toxicity of copper. For each of the three water hardnesses tested, the LC50 was significantly higher in water containing 1.4 mg HA/l than in the same water to which no HA had been added. Reproduction was not a sensitive index of copper stress in daphnids. The accumulation of copper by daphnids was affected by water hardness, humic acid concentration and age at which animals were exposed to copper. The effect of water hardness on bioaccumulation was consistent for the two age groups and the reduction in copper bioaccmulation associated with a hardness increase from 58 to 115 mg/l can be interpreted as a result of an increased competition of Ca(2+) with Cu(2+) for binding sites at biosurfaces. The inhibiting effect of HA on bioaccumulation of copper by older daphnids decreased as water hardness increased. The effect of HA on bioaccumulation and toxicity of copper would appear to depend on the relative concentrations of Ca(2+), Mg(2+), and Cu(2+) in relation to HA concentration. Therefore, although Ca(2+) and Mg(2+) may have no direct effect on copper toxicity they may have an indirect effect through their interaction with humics. (Baker-IVI)
W85-06732

TRACE METALS IN SHATT AL-ARAB RIVER, IRAQ,
Basrah Univ. (Iraq). Marine Science Centre.
J. K. Abaychi, and A. A. Z. DouAbul.
Water Research, Vol. 19, No. 4, p 457-462, 1985. 1 Fig, 5 Tab, 23 Ref.

Descriptors: *Trace metals, *Shatt Al-Arab River, *Iraq, *Arabian Gulf, Sediments, Particulates, Metals, Organic carbon, Geology, Catchment area.

The distribution of ten trace metals was investigated in the Shatt al-Arab River. The river originates from the confluence of the two major rivers of Iraq at Qurna. Karun River, the only tributary of the Shatt al-Arab River, joins its eastern bank south of Basrah City. The length of the Shatt al-Arab River from Qurna to its mouth in the Arabian Gulf is about 175 km. Shatt al-Arab waters are characterized as being well mixed with limited vertical stratification of temperatures and chlorinities. Low trace metal concentrations were encountered in the water along with low concentrations of particulate matter and surficial sediment. The rather high concentrations of both Ni and V have been attributed to the petroleum-rich substrate of the region. Hence, trace metals content in the Shatt al-Arab River seeems to be controlled by the abundance of metals in the rocks and soil of the river's catchment area and by their geochemical mobility. There are substantial numbers of signifi-

cant and highly significant inter-element correlations. The most striking feature is the absence of significant correlation between the mean grain size and the total organic carbon content of the sediment with most of the trace metals studied in the River. (Baker-IVI)
W85-06733

COMPARISON OF HEAVY METALS IN AQUATIC PLANTS ON CHARITY ISLAND, SAGINAW BAY, LAKE HURON, U.S.A., WITH PLANTS ALONG THE SHORELINE OF SAGINAW BAY,
Michigan Univ., Ann Arbor. Div. of Biological Sciences.
G. F. Estabrook, D. W. Burk, D. R. Inman, P. B. Kaufman, and J. R. Wells.
American Journal of Botany, Vol. 72, No. 2, p 209-216, February, 1985. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Heavy metals, *Aquatic plants, *Michigan, *Charity Island, *Lake Huron, *Saginaw Bay, Neutron activation analysis, Silver, Aresnic, Barium, Cadmium, Cesium, Cobalt, Chromium, Nickel, Antimony, Thorium, Uranium, Zinc.

The concentrations of 15 heavy metals in aquatic plants on Charity Island was compared to those in plants on the shoreline of Saginaw Bay, Lake Huron. Heavy metal concentrations were measured by neutron activation analysis. Significant trends were encountered in 13 of 15 metals of which 9 (Ag, As, Ba, Cd, Ni, Rb, Se, Th, U) have significantly higher concentrations in the Island plants than in the plants along the shoreline of the bay. Higher values from the shoreline of Saginaw Bay were observed for Co, Cs, Sb, and Zn, but the shoreline samples also had most of the not detectable values. The location of Charity Island offers a more moderate climate than the shoreline of the bay. The bay surrounds Charity Island, keeping it cooler in the spring, and warmer than the mainland, well into the fall. The growth level of aquatic macrophytes achieved by summer is also an important factor that determines, in part, the capability and efficiency of these plants as sinks for heavy metals. The ratio of good heavy metal accumulators to all heavy metal accumulators was about the same on Charity Island and along the Saginaw Bay shore; at both sites, approximately 25% of the species sampled were good heavy metal accumulators. An understanding of heavy metal accumulation by aquatic macrophytes will contribute to an understanding of the spatial dynamics of heavy metal distribution, which in turn may enable one to more effectively control this dangerous class of pollutants, without unnecesarily reducing the efficiency of industrial activities. (Baker-IVI)
W85-06740

CONTAMINATION AND EFFECTS IN FRESHWATER DITCHES RESULTING FROM AN AERIAL APPLICATION OF CYPERMETHRIN,
Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.
For primary bibliographic entry see Field 5C.
W85-06742

FATE OF CHEMICALS IN AQUATIC SYSTEMS: PROCESS MODELS AND COMPUTER CODES,
Environmental Research Lab., Athens, GA.
L. A. Burns.
ACS Symposium Series, Vol. 225, p 25-40, 1983. 1 Fig, 56 Ref.

Descriptors: *Fate of pollutants, *Model studies, *Computers, *Aquatic environment, Transport, Transfer, Ionization, Sorption, Biosorption, Bioaccumulation, Volatilization, Photolysis, Hydrolysis, Oxidation, Biotransformation.

Aquatic fate models must account for several kinds of phenomena, including transport and transfer processes that move a compound among ecosystem segments and compartments, and degradation processes that convert the compound to transformation products. A brief summary is provided of the quantitative basis for describing these processes, a description of the logic and data structures used to assemble fate codes, and a brief catalog of some of the main publicly available, better documented computer programs for aquatic fate. Transport and transfer processes considered include hydrodynamic transport, ionization, sorption, particle transport, interactions with benthic subsystems, biosorption, bioaccumulation, and volatilization. Transformation processes considered include direct photolysis, indirect photolysis and oxidation, hydrolysis, and microbial biotransformation. Logical and data structures of aquatic fate codes and considered with available aquatic fate codes described including EXAMS1/EMANS2, HSPF, PEST, SRI/SERATRA/TODAM/FETRA/CMRA, TOXIC, UTM-TOX, and WASP/TOXIWASP/WASTOX. (Baker-IVI)
W85-06765

SOIL AND GROUNDWATER FATE MODELING,
Little (Arthur D.), Inc., Cambridge, MA.
M. Bonazountas.
ACS Symposium Series, Vol. 259, p 41-65, 1983. 2 Fig, 4 Tab, 37 Ref.

Descriptors: *Model studies, *Groundwater movement, *Soil water, *Fate of pollutants, Unsaturated zone, Saturated zone, Chemical reactions, Mathematical models, Groundwater pollution, Soil contamination.

Soil compartment chemical fate modeling has been traditionally performed for three distinct subcompartments: land surface, the unsaturated soil zone, and the saturated zone of a region. Pollutants are released to the soil compartment through numerous human activities. Land disposal sites result in soil contamination through leachate migration. Pollutant sources include industrial, municipal, household, agricultural, mining, petroleum exploration and cooling water waste disposal. Environmental factors and the chemistry of waste deposits are reviewed with emphasis on physical processes (sorption/ion-cation exchange, diffusion/volatilization), chemical processes (ionization, hydrolysis, oxidation/reduction, complexation) and biological processes (bioaccumulation and biodegradation). Mathematical modeling is considered with emphasis on unsaturated soil zone modeling (TDE modeling, compartmental modeling, stochastic modeling and probabilistic modeling); physical, chemical, and biological processes modeled; saturated soil zone (groundwater) modeling; ranking modeling; and aquatic equilibria models. Selected models and issues described include PESTAN, SCRAM, SESOIL, PATHS, AT123D and MMT. (Baker-IVI)
W85-06766

NEW MATHEMATICAL MODELING SYSTEM,
University of the Pacific, Stockton, CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W85-06767

INTERACTIONS BETWEEN DISSOLVED HUMIC AND FULVIC ACIDS AND POLLUTANTS IN AQUATIC ENVIRONMENTS,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
C. W. Carter, and I. H. Suffet.
ACS Symposium Series, Vol. 259, p 215-229, 1983. 6 Fig, 2 Tab, 24 Ref.

Descriptors: *Fate of pollutants, *Mathematical models, *Humic acids, *Fulvic acids, Organic compounds, Solubility, Pesticides, DDT, DEPH, Lindane, Sorption, Sediments.

A number of mathematical models have been developed in recent years which attempt to predict the behavior of organic water pollutants. Work on the binding of pesticides and other pollutants by dissolved humic materials is summarized. Specific topics of discussion include methods available for quantitatively measuring the extent of binding of organic pollutants to dissolved humic materials, comparisons between methods, quantitative binding measurements, binding of various compounds by Pakim Pond Humic Acid, and binding of DDT by various humic materials. The extent of binding for a particular compound is related to the octanol/water partition coefficient for that compound. This is very similar to the sorption of compounds from water to sediment. Compounds with log Kow values less than four (such as Lindane) will probably not be bound to an appreciable extent in the environment. Compounds with very high log Kow values (DDT and DEHP) may be bound to a significant extent. The extent of binding will depend on both the concentration of humic material and on the nature of the humic material. The humic materials used in this research showed dramatically different affinities for DDT. The reasons for this are poorly understood and require further study. (Baker-IVI)
W85-06768

MATHEMATICAL MODELING APPLICATION TO ENVIRONMENTAL RISK ASSESSMENTS,
CIBA-GEIGY Corp., Greensboro, NC. Agricultural Div.
R. C. Honeycutt, and L. G. Ballantine.
ACS Symposium Series, Vol. 259, p 249-262, 1983. 1 Fig, 9 Tab, 3 Ref.

Descriptors: *Insecticides, *Mathematical models, *Environmental risk assessments, Runoff, Toxicity, Model studies, Path of pollutants, Fate of pollutants.

With any environmental risk assessment of a chemical, there are three factors: the environmental fate of a chemical; the exposure to the chemical; and the toxicity of the chemical to organisms inhabiting the environment in question. CGA-72662, a CIBA-GEIGY insect growth inhibitor, is used as an example to show how a risk assessment can be carried out using the SWRRB runoff model coupled to the EXAMS fate model. CGA-72662 is an insecticide which is being developed for use on celery in Florida. A description is offered of the runoff SWRRB and the EXAMS models. The use of SWRRB and EXAMS to assess the hazard of CGA-72662 to an aquatic environment is demonstrated with emphasis on SWRBB-EXAMS interconnections and the calculation for load input into EXAMS pond, the use of EXAMS ponds and lakes to determine environmental fate of CGA-72662, limitations of SWRRB and EXAMS models, SWRRB limitations and pitfalls, and EXAMS limitations and pitfalls. (Baker-IVI)
W85-06769

FATE OF CHEMICAL INSECTICIDES IN AQUATIC ENVIRONMENTS, FOREST SPRAYING IN CANADA,
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
K. M. S. Sundaram, P. D. Kingsbury, and S. B. Holmes.
ACS Symposium Series, Vol. 238, p 253-276, 1984. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Insecticides, *Forest watersheds, *Fate of pollutants, *Aquatic environments, Water pollution sources, Transport, Volatilization, Dilution, Distillation, Plants, Fish, Insects, Adsorption, Suspended particulates, Microbial degradation.

The environmental behavior of some forestry insecticides in aquatic systems was studied under controlled conditions in laboratory model ecosystems and in forest streams following experimental stream injections or operational forest spraying. In dynamic stream ecosystems applied chemicals reaching stream surfaces are rapidly lost by transport, dilution, volatilization and co-distillation. The small fraction that persists in water disappears partly by absorption by aquatic organisms such as plants, insects and fish, and also by adsorption onto suspended particulates, where it likely degrades by microbial reduction. In the light of this, if current use patterns are rigidly adhered to and where necessary, improved and modified, these chemicals could seldom pose any significant long-term harm (biomagnification and resultant damage) to the aquatic ecosystem. (Baker-IVI)
W85-06770

FATE OF FENITROTHION IN SHADED AND UNSHADED PONDS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
G. P. Malis, and D. C. G. Muir.
ACS Symposium Series, Vol. 238, p 277-295, 1984. 2 Fig, 7 Tab, 19 Ref.

Descriptors: *Fenitrothion, *Fate of pollutants, *Ponds, *Shade, Organic compounds, Degradation, Sunlight, Radiation, Insecticides, Solar radiation, Pesticide residues, Carbon radioisotopes.

Fenitrothion (labelled with C-14) was applied to two outdoor ponds at a rate of 165 g/ha on two consecutive years. One pond was shaded from direct sunlight with black polyethylene for the first 17 days of the experiment to simulate a forest pond. Initial concentrations of the insecticide in water were about 70 micro-g/l. The effect of shading after fenitrothion addition was to increase the half-life of the insecticide by about 50%. Despite a 30-fold reduction in light intensity, the decline in insecticide residues in water was rapid dropping from 70 micro-g/l to about 0.01 micro-g/l by 17 days. Shaded condition decreased the quantities of other products and MNP that were formed, however, no major products unique to shaded or unshaded conditions were identified. A large portion of radioactivity in water, sediment and plants was unextractable with conventional techniques, especially in samples taken after 10 days post-treatment. Volatilization from water was slow compared to other paths of degradation of the insecticide. The radioactivity added to the ponds was only accounted for successfully during the first 5 days of post-treatment despite knowledge of the size of the major compartments and the use of direct assays such as combustion to C-14 labelled CO2. Loss of radioactivity due to penetration to lower depths in sediment and degradation of the ring label to volatile carbon fragments and C-14 labelled CO2 in the water column may have occurred but are unlikely to total all of the 70-80% unaccounted for. The ultimate fate of the radiolabelled material in aquatic systems under field conditions is needed for further study. (Baker-IVI)
W85-06771

RADIONUCLIDE SORPTION AND DESORPTION REACTIONS WITH INTERBED MATERIALS FROM THE COLUMBIA RIVER BASALT FORMATION,
Atomics International Div., Richland, WA. Energy Systems Group.
G. S. Barney.
ACS Symposium Series, Vol. 246, p 3-23, 1984. 4 Fig, 7 Tab, 10 Ref.

Descriptors: *Radioisotopes, *Adsorption, *Desorption, *Geochemistry, *Columbia River Basalt Formation, Fate of pollutants, Groundwater, Cesium, Strontium, Radium, Technetium, Neptunium, Plutonium, Uranium, Minerals, Hysteresis, Radioactive wastes.

Sorption and desorption behavior of radionuclides was studied in three samples from groundwater-interbed systems of the Columbia River (USA) basalt formation. A sandstone and a tuff from the Rattlesnake Ridge Interbed and a sandstone/claystone from the Mabton Interbed were employed in batch equilibration experiments with tracers, three types of synthetic groundwater, and interbed solids. Triplicate measurements were made for various combinations of temperature, redox (Eh) condition, tracer concentration, tracer type, groundwater composition, and interbed sample; constant temperatures were maintained. Sodium, potassium, and calcium in the groundwater decreased sorption of cesium, strontium, and radium by ion exchange reactions. Groundwater Eh strongly affected sorption of technetium, neptunium, plutonium, and uranium. Effects on sorption from radionuclide complexation by groundwater anions were not observed except for neptunium carbonate (or bicarbonate) complexes and plutonium sulfate complexes. Sorption and desorption isotherms obtained under oxidizing and reducing conditions were accurately described by the Freundlich equation except when precipitation of the radionuclide occurred. Most radionuclides were apparently irreversibly sorbed on each of the geologic solids because the slopes of sorption and desorption isotherms for a given radionuclide were different. This hysteresis effect was very large, and should cause a significant delay in radionuclide transport. The hysteresis effect should be included by modeling radionuclide transport as part of assessment of the isolation capabilities of basalt for safety of a high-level radioactive waste repository. (Rochester-IVI)
W85-06773

INTERACTION OF GROUNDWATER AND BASALT FISSURE SURFACES AND ITS EFFECT ON THE MIGRATION OF ACTINIDES,
Argonne National Lab., IL.
G. F. Vandegrift, D. L. Bowers, T. J. Gerding, S. M. Fried, and C. K. Wilbur.
ACS Symposium Series, Vol. 246, p 229-247, 1984. 4 Fig, 6 Tab, 15 Ref.

Descriptors: *Radioactive wastes, *Fate of pollutants, *Groundwater pollution, *Basalt, Geological fractures, Calcium, Potassium, Bentonite, Radioisotopes, Actinides, Geochemistry.

Analog experiments designed to simulate conditions existing in the event of a breach in a nuclear waste repository in basalt suggested a strong correlation between changes in groundwater composition and radionuclide retardation in basalt. Synthetic groundwater was pumped through a series of three vessels containing, 1) basalt chips, bentonite, and the glass waste form; then 2) bentonite and basalt chips; and finally 3) a narrow basalt fissure. Results suggest that fresh, unaltered basalt fissures and surfaces will not be in equilibrium with ground water than enters the nuclear waste repository area (Hanford, Washington). A steady-state groundwater composition will be achieved in a relatively short time (20-25 days in the laboratory); Ca(2+) and K(+) will be increased above initial concentrations, and Na(+) and pH will be decreased, probably due to hydrolysis and alteration of minerals on the basalt surface. While bentonite is transported by flowing, unaltered groundwater, interaction with unaltered basalt surfaces appears to agglomerate it and bind it to the basalt. Unaltered basalt appears to effectively limit the migration of actinides dissolved or suspended in the groundwater. Gamma radiation does not substantially affect groundwater compositional changes due to interactions with unaltered bentonite and basalt, but appears to generate identifiable differences in actinide leaching from the waste form. Gamma radiation perceptibly modifies leaching characteristics of the waste form. The mechanism responsible for actinide retardation in basalt fissures is unknown. (Rochester-IVI)
W85-06774

ROLE OF ORGANICS IN THE SUBSURFACE MIGRATION OF RADIONUCLIDES IN GROUNDWATER,
Battelle Pacific Northwest Labs., Richland, WA.
A. P. Toste, L. J. Kirby, and T. R. Pahl.
ACS Symposium Series, Vol. 246, p 251-270, 1984. 3 Fig, 6 Tab, 10 Ref.

Descriptors: *Radioactive waste, *Waste disposal, *Fate of pollutants, *Groundwater pollution, Maxey Flats, Kentucky, Groundwater movement, Migration, Geological fractures, EDTA, Organic compounds, Radioisotopes.

Subsurface migration of radionuclides has been studied at the Maxey Flats burial site, Kentucky, where the groundwater is anoxic. The Maxey Flats site is one of several commercial shallow land burial sites for low-level radioactive waste in the eastern United States where rainfall is comparatively high. Trench cap subsidence and infiltration of surface water into waste trenches are greater problems at wet eastern sites compared to arid western sites. Factors governing the subsurface migration of radionuclides appear to be extremely complex. A study has been completed of radionuclide migration and groundwater movement in an experimental study area constructed adjacent to a waste-filled trench. Currently underway is a research effort aimed at elucidating the role of organic species in the subsurface migration of radionuclides. A survey study has been completed aimed at mapping the organic content of various groundwater samples from waste trenches and the experimental study area. A detailed chemical speciation study was also begun to determine which organic compounds identified in the survey study are complexed or chelated to radionuclides. Certain radionuclides (H-3, Pu-238, Pu-239, Pu-240, Sr-90, Co-60, and Cs-137) have migrated within the study area over relatively short distances of 4 to 7 m. The chelator EDTA and three EDTA-like fragments are the major hydrophilic organic species (ppm levels) in leachate from two waste trenches and one inert atmosphere well. Trace levels of hydrophobic organic species (generally ppb levels), including two barbiturates, were also identified in waste leachate and water from an inert atmosphere well. On the basis of steric exclusion chromatography, it is clear that polar organic species in the groundwaters co-elute with certain radionulcides and are, therefore, presumably chelated. Pu and Co-60 coelute with EDTA. The appearance of EDTA and the barbiturates in only one inert atmosphere well argues that communication between the waste-filled area and the experimental study area is very specific, presumably via fracture flow. Radionuclide, inorganic and organic data indicate that the groundwater flow patterns are complex, at least in the vicinity of the experimental study area. (Baker-IVI)
W85-06775

RELEASES OF RADIUM AND URANIUM INTO RALSTON CREEK AND RESERVOIR, COLORADO, FROM URANIUM MINING,
Geological Survey, Denver, CO.
I. C. Yang, and K. W. Edwards.
ACS Symposium Series, Vol. 246, p 271-286, 1984. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Uranium, *Radium, *Path of pollutants, *Colorado, *Ralston Creek, *Ralston Reservoir, Creeks, Reservoirs, Uranium mining, Sediments, Suspended solids, Particle size, Mining.

Dissolved U concentrations were determined in wastewater from a uranium mine, in water fom Ralston Creek (Colorado) upstream from and downstream from the discharge point, and from Ralston Reservoir, located 2.5 mi downstream from the mine. Dissolved Ra-226 concentrations in the mine effluent, the creek and the reservoir were all less than the limit of 3 pCi/l set by drinking water regulations, whereas dissolved U in Ralston Creek ranges from 600 to 1200 micro-g/l and is 1,700 micro-g/l in the mine outflow. The EPA is planning to set a guidance level of 10 pCi/L (14.7 micro-g/l) of U in drinking water. The mine operator also is studying ways to remove U from the water. Suspended Ra-226 and U concentrations were very high, as much as 600 pCi/g for Ra-226 and 1,000 micro-g/g for U in the creek, and 20 pCi/g for Ra-226 and 200 micro-g/g for U in the reservoir. In bottom sediment from the creek bed, concentrations of both radionulcides increase as particle-size decreases, and as distance downstream from the mine decreases. The greatest concentrations of Ra-226 and U in the sediment are several tens to hundreds of times greater than the background concentrations. The greater than natural radioactivity in the sediment of Ralston Creek may be partly due to U-ore particles discharging directly into the creek during the early days of the mine operation and partly due to suspended solids of Ba(Ra)SO4 and fine U-ore from present day discharges. Leaching studies indicate that these radionuclides associated with sediment are not in the form of adsorbed ions, but in the form of discrete minerals, or are partly trapped inside the colloidal hydroxides of Fe and Mn coated on the sediment. (Baker-IVI)
W85-06776

URANIUM MOBILITY IN THE NATURAL ENVIRONMENT; EVIDENCE FROM SEDIMENTARY ROLL-FRONT DEPOSITS,
Battelle Pacific Northwest Labs., Richland, WA.
W. J. Deutsch, and R. J. Serne.
ACS Symposium Series, Vol. 246, p 287-302, 1984.

6 Fig, 2 Tab, 21 Ref. DOE contract DE-AC06-76RL0 1830.

Descriptors: *Uranium, *Path of pollutants, *Radioactive wastes, Model studies, Computers, Transport, Groundwater pollution, Leaching, Geochemistry, Simulation, Hydrogen ion composition, Water temperature, Mining.

The behavior of uranium stored as nuclear waste in a geologic repository will be partially controlled by the geochemical environment of the repository. The effect of groundwater leaching on the waste can be simulated by estimating a groundwater composition and then using an equilibrium thermodynamic computer model to simulate the interaction of the waste with the solution. Roll-front deposits consists of naturally occurring ore-grade U in sandstone aquifers. The geochemical environment of these roll-front deposits is analogous to the environment of a radioactive waste repository containing redox-sensitive elements during its post-thermal period. In typical aquifers with oxidizing groundwater, uranium's concentration in solution appears to be limited by its abundance in source rocks. The uranium in ground water is removed from solution and deposited at a redox interface between sediments with reducing minerals and sediments without. If the environmental condition of the ore zone changes as a result of either natural or manmade causes, the uranium can become very mobile. This is evidenced by the in situ mining process in which relatively minor modifications are made to the groundwater chemistry to produce a solution that can rapidly dissolve uranium and maintain uranium solution concentrations of hundreds of parts per million. The effect of changing environmental conditions on the stability of the uraninite was determined through a model study and the amount of uranium that might be expected in solution was estimated. The pH, Eh, and temperature of the groundwater each significantly affected the dissolution of the uraninite. This type of simulation can be useful in assessing the environmental compatibility of various proposed deep geologic repository sites to the waste form. Although a given waste form may dissolve rapidly under certain breach conditions, uranium may not be very mobile in a deep aquifer where reducing conditions are reestablished after the groundwater moves away from the repository. (Baker-IVI)
W85-06777

EFFECTS OF WATER FLOW RATES ON LEACHING,
Illinois Univ. at Urbana-Champaign.
C. Pescatore, and A. J. Machiels.
ACS Symposium, Vol. 246, p 349-358, 1984. 4 Fig, 12 Ref.

Descriptors: *Flow rates, *Leaching, *Glass, Permeability, Radioactive waste disposal, Path of pollutants, Groundwater pollution, Solubility.

In glass leaching experiments, using complex, simulated nuclear waste glasses, the rate of renewal of the corrosion solution is an important system parameter. The distinguishing feature of the flow rate effects on leaching is that they determine the long-term rate controlling leaching mechanisms. Under dynamic leaching conditions saturation of the solution is never achieved; steady state elemental releases are thus controlled by dissolution of the glass network. The higher the flow rate, the faster steady-state is approached, and the higher the resulting leach rates. Under low groundwater flow rates, leaching is controlled eventually by the selective release from the glass of modifer species which have high solubilities in water. The release of species with lower solubilities than the network former controlling the dissolution process may or may not slow down leaching of both glass modifiers and network formers. In general, the mechanistic leaching code LIX appears particularly well suited for deriving from information obtained in static tests the leach rates applicable to any flow conditions, including the low flow conditions which are difficult to simulate experimentally. (Baker-IVI)
W85-06778

TOXINS FROM FRESHWATER CYANOBACTERIA,
Wright State Univ., Dayton, OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W85-06779

PESTICIDE AVAILABILITY INFLUENCE OF SEDIMENT IN A SIMULATED AQUATIC ENVIROMENT,
Agricultural Research Service, Beltsville, MD. Pesticide Degradation Lab.
A. R. Isensee.
ACS Symposium Series, Vol. 259, p 261-277, 1984. 4 Fig, 6 Tab, 6 Ref.

Descriptors: *Pesticides, *Insecticides, *Sediments, *Aquatic environment, *Fate of pollutants, DDT, DDD, DDE, Path of pollutants, Enviromental protection, Fish, Snails, Algae, Daphnia, Chlorinated hydrocarbons.

Sediment additions were made to model aquatic environments containing DDT equilibrated between sediment, water, and four species of aquatic organisms to determine if pesticide availability to biota was reduced through normal sedimentation events. Soil treated with C-14-labeled DDT at 10, 100, and 1000 ppm was flooded and fish (Gambusia affinis), snails (Helosoma sp.), algae (Oedogonium cardiacum), and daphnids (Daphnia magna) were added. At two-wk intervals, untreated sediment additions (equalling 1% of the water weight) were made. Samples of water and organisms, taken before and after sediment additions, were analyzed for DDT, DDE, and DDD and compared to equilibrated systems not treated with sediment. DDT content in water decreased 3- to 9- fold by the first sediment addition. Polar metabolites in water increased as DDT decreased. Fish were killed at the 1000 ppm level and daphnids succumbed at 100 and 1000 ppm levels. Sediment additions substantially reduced the toxicity at lower treatment levels. Sediment additions decreased total C-14 by 6 to 13% in fish, 20 to 40% in algae, 45 to 50% in snails and 55% in daphnids (10 ppm rate). Measureable levels of DDT do not diffuse through 1 cm or more of untreated soil into water in one yr. Covering pesticide contaminated sediment with soil and sediment in situ is an effective contamination control method under certain aquatic conditions. (Author's abstract)
W85-06783

POTENTIAL PESTICIDE CONTAMINATION OF GROUNDWATER FROM AGRICULTURAL USES,
Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.
S. Z. Cohen, S. M. Creeger, R. F. Carsel, and C. G. Enfield.
ACS Symposium Series, Vol. 259, p 297-325, 1984. 5 Tab, 121 Ref.

Descriptors: *Pesticides, *Groundwater pollution, Fate of pollutants, Chemical properties, Chemical properties, Soil properties, Agricultural chemicals, Hydrolysis, Photolysis, Pesticides residues.

Combinations of pesticide characteristics and field conditions most likely to be associated with groundwater contamination as a result of agricultural use are given based on a summary of chemical uses and properties and current monitoring data. Chemical characteristics and monitoring data are reviewed for alachlor, aldicarb and products, atrazine, bromacil, carbofuran, 1,2-dibromo-3-chloropropane (DBCP), dimethyl tetrachloroterephthalate (DCPA) and products, dichloropropane, dinoseb, 1,2-dibromoethane (EDB), oxamyl, and simazine. The key environmental fate parameters for mathematical modeling, K sub oc (= soil water distribution coefficient, K sub d, divided by soil organic carbon content), K sub d, solubility, hydrolysis half-life, soil/field dissipation half-life, and pK sub a, are tabulated for these pesticides. Based on the limited data available, certain chemical characteristics in combination with certain field characteristics appear to be associated with a high potential for groundwater contamination. Chemical characteristics are solubility in water > about 30 ppm, K sub d < 5, usually < 1 or 2, K sub oc < 300-500, Henry's law constant of < 0.01 atmosphere-cu m/mol, either fully or partially negatively charged at ambient pH, hydrolysis half-life of about 25 wk, photolysis half-life of > about 1 wk, and soil half-life > 2-3 wk. Field conditions are total precipitation and irrigation recharge > about 25 cm/yr (high recharge typically is associated with low moisture holding capacity of the soil), high levels of nitrates in ground water, porous soil above an unconfined aquifer, and a soil pH providing high stability to pesticide residues. These generalizations also may apply to some degree to uncontrolled hazardous waste sites. (Rochester-IVI)
W85-06784

NITROGEN AND PHOSPHORUS IN ROTORUA URBAN STREAMS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
R. A. Hoare.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 4, p 451-454, 1984. 4 Tab, 4 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Lake Rotorua, *New Zealand, *Urban catchments, *Fate of pollutants, Water pollution effects, Nutrients, Wastewater treatment, Septic tanks, Septic wastewater.

Three suburban catchments of Lake Rotorua (New Zealand) were surveyed as part of the establishment of the Lake's nutrient budget. The catchments contribute about 2% of the inorganic nitrogen load and much less than 1% of the phosphorus load. However, nitrate concentrations in urban streams at Rotorua are an order of magnitude higher than those in nearby rural streams. The loads of nitrogen are consistent with the loads discharged to septic tanks in the stream catchments. Despite the large number of septic tanks in the catchment, phosphorus concentrations are no higher than in rural streams, and phosphorus loads in the streams are less than 2% of the load on the septic tanks. The soil is apparently capable of retaining almost all of the phosphorus load from septic tanks. Nitrate in the streams is slowly decreasing now that a sewerage reticulation system is almost complete. Phosphorus load on the lake from buildings in these suburban catchments will be increased by the installation of sewerage, unless effluent from the treatment plant is diverted from the lake, or very good phosphorus stripping is incorporated in the treatment process. Since the effects studied in these catchments are probably generally occurring in the Rotorua suburban area, the overall effect of sewerage reticulation on the lake could be quite important. (Collier-IVI)
W85-06796

WITHOUT WATER THE WORK OF DEATH WOULD BE INCOMPLETE,
Glasgow Univ. (Scotland). Dept. of Microbiology.
For primary bibliographic entry see Field 2K.
W85-06800

SULPHATE AND NITRATE CONCENTRATIONS IN SNOW FROM SOUTH GREENLAND 1895-1978,
Bern Univ. (Switzerland). Physikalisches Inst.
A. Neftel, J. Beer, H. Oeschger, F. Zurcher, and R. C. Finkel.
Nature, Vol. 314, No. 6012, p 611-613, April 18, 1985. 3 Fig, 1 Tab, 24 Ref.

Descriptors: *Sulfates, *Nitrates, *Snow, *Greenland, *Acid rain, Hydrogen ion concentration, Ice, Rain, Water pollution sources, History.

An understanding of the phenomenon of acid rain requires the identification of the sources of the species affecting the pH of rainwater, both natural and anthropogenic, and their temporal and spatial development. The scant data concerning the historical development of the acidity in precipitation are from urban regions or their vicinity, where local effects dominate and obscure the hemispherical pattern. The Greenland ice sheet allows us to

trace the evolution of the acid rain in a remote location that is free from local effects. Sulfuric and nitric acids are the two species that dominate the acidity in precipitation. We report here measurements of SO4(-2) and NO3(-) concentrations in firn samples spanning the period 1895-1978. Samples, each covering 1 yr, were taken from a 70-m core drilled at Dye 3, South Greenland; NO3(-) and SO4(-2) both increased by a factor of approximately 2 during the period. By comparing the recent concentrations of nitrate and sulfate with those resulting from natural sources, we conclude that anthropogenic emissions of the precursors (NOx, SO2) had already surpassed natural sources in the late 1950s. (Author's abstract)
W85-06801

CHANGES IN CHEMICAL COMPOSITION OF PRECIPITATION AS IT FALLS (OB IZMENENII KHIMICHESKOGO SOSTAVA ATMOSTERNYKH OSADKOV V PROTSESSE IKH VYPADENIYA),
T. N. Gromova, G. B. Sveshnikov, and T. M. Ungerman.
Vestnik Leningradskogo Universiteta Geologiia-Geografiia, Vol. 24, p 80-85, 1984. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Precipitation chemistry, *Fate of pollutants, *Northern Moldavia, *USSR, Sulfates, Chlorides, Nitrates, Carbonates, Sodium, Potassium, Magnesium, Calcium, Ammonium, Hydrogen ion concentration.

The changes in chemical composition of atmospheric precipitation in the process of natural washing-out of pollutants from the atmosphere were presented. The change of macroelement composition of precipitation is particularly significant during the first 40-60 min of its fall while the microelement content changes little with time. The investigation was carried out in the summer periods of 1976-1980 in the Northern Moldavia (the Soroksky district) (USSR). (Author's abstract)
W85-06808

RADIONUCLIDE LEVELS AND DISTRIBUTION IN GRAZED SALTMARSH IN WEST CUMBRIA,
Institute of Terrestrial Ecology, Grange over Sands (England). Merlewood Research Station.
A. D. Horrill.
Environmental Pollution (Series B), Vol. 8, No. 4, p 265-280, 1984. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Radioisotopes, *Salt marshes, *Cumbria, *England, *Fate of pollutants, Vegetation, Water pollution sources, Marshes, Tidal marshes, Vegetation, Fowl, Sheep, Fowl, Water pollution effects.

Radionuclides discharged by the nuclear reprocessing plant at Sellafield (formerly Windscale) are being accumulated in sediments in the estuary complex formed by the Rivers Irt, Mite and Esk at Ravenglass, Cumbria, England. Radionuclide levels and distribution in the surface silts and vegetation of the saltmarsh were investigated as they are the basis for pathways to man via grazing animals and, to a lesser extent, wildfowl. The grazed area was compared to a previously described ungrazed area in the same estuary complex. A complete gamma spectrum was obtained for samples of vegetation and silt using a pair of coaxial Ge(Li) detectors. Variability in the grazed area is large spatially and other work has demonstrated that a temporal element is also present. Stratification based on the vegetation is less successful in reducing the spatial variation than previously described ungrazed marsh. This can be explained by the absence of a physical structure due to heavy grazing pressures. Accumulation of radionuclides appears to be primarily a physical process dominated by tidal factors. A second important influence is the physical structure of the vegetation present on the saltmarsh. The levels present on the vegetation, heavily grazed by sheep and some estuarine birds, are important when transfers are considered. Radionuclides seem to be associated with the fine grain silt deposits on the vegetation and thus biological activity may be relatively low. The high levels of variability found within a distance of a few hundred meters, c. 20-460 pCi/g in the case of Cs-137, have important implications when sampling schemes are considered for research or monitoring programs. (Collier-IVI)
W85-06814

CONTAMINATION OF AQUIFERS BY OVERPRESSURING THE ANNULUS OF OIL AND GAS WELLS,
Allegheny Coll., Meadville, PA.
S. S. Harrison.
Ground Water, Vol. 23, No. 3, p 317-324, May-June, 1985. 6 Fig, 7 Ref.

Descriptors: *Aquifers, *Hydrodynamic pressure, *Oil wells, *Gas wells, *Wells, *Groundwater contamination, Well casings, Water pollution prevention, Water pollution sources, Environmental protection.

Medina gas wells and oil wells in northwestern Pennsylvania, northeastern Ohio, and western New York create a potential for contamination of the fresh-water aquifers that overlie the production zones of these wells. Most of these wells are constructed in a manner which results in an open annulus which is a few hundred to a few thousand feet long below the surface casing of the well. This annulus is a potential avenue of migration of contaminants from strata of higher hydrodynamic pressure into formations of lower hydrodynamic pressure. If gas from the strata exposed to the annulus is not permitted to escape to the atmosphere, the annulus may become pressurized, and a hydraulic gradient may be created between the potential contaminants in the annulus (e.g., brine and/or natural gas) and the overlying fresh-water aquifers. If a permeability pathway exists between the pressurized annulus and an overlying fresh-water aquifer, contamination of the aquifer will result. The risk of contaminating fresh groundwater with the contents of a gas- or oil-well annulus could be greatly reduced by filling the annulus with cement. An alternative precaution would be to operate the well in a manner that does not allow the annulus pressure to exceed the normal pressure of the formations exposed to the annulus. (Author's abstract)
W85-06820

DISTRIBUTION OF VOLATILE ORGANIC COMPOUNDS IN A NEW JERSEY COASTAL PLAIN AQUIFER SYSTEM,
Geological Survey, Trenton, NJ.
T. V. Fusillo, J. J. Hochreiter, and D. G. Lord.
Ground Water, Vol. 23, No. 3, p 354-360, May-June, 1985. 6 Fig, 3 Tab, 10 Ref.

Descriptors: *New Jersey, *Pennsylvania, *Potamac Aquifer, *Raritan Aquifer, *Magothy Aquifer, *Aquifers, *Groundwater contamination, *Volatile organic compounds, Path of pollutants, Trichloroethylene, Tetrachloroethylene, Benzene, Aromatic hydrocarbons, Chlorinated hydrocarbons, Water pollution sources.

Samples for analysis of volatile organic compounds were collected from 315 wells in the Potomac-Raritan-Magothy aquifer system in southwestern New Jersey and a small adjacent area in Pennsylvania during 1980-82. Volatile organic compounds were detected in all three aquifer units of the Potomac-Raritan-Magothy aquifer system in the study area. Most of the contamination appears to be confined to the outcrop area at present. Low levels of contamination, however, were found downdip of the outcrop area in the upper and middle aquifers. Trichloroethylene, tetrachloroethylene, and benzene were the most frequently detected compounds. Differences in the areal distributions of light chlorinated hydrocarbons, such as trichloroethylene, and aromatic hydrocarbons, such as benzene, were noted and are probably due to differences in the uses of the compounds and the distribution patterns of potential contamination sources. The distribution patterns of volatile organic compounds differed greatly among the three aquifer units. The upper aquifer, which crops out mostly in less-developed areas, had the lowest percentage of wells with volatile organic compounds detected (10 percent of wells sampled). The concentrations in most wells in the upper aquifer which had detectable levels were less than 10 micro g/l). In the middle aquifer, which crops out beneath much of the urban and industrial area adjacent to the Delaware River, detectable levels of volatile organic compounds were found in 22 percent of wells samples, and several wells contained concentrations above 100 micro g/l. The lower aquifer, which is confined beneath much of the outcrop area of the aquifer system, had the highest percentage of wells (28 percent) with detectable levels. This is probably due to (1) vertical leakage of contamination from the middle aquifer, and (2) the high percentage of wells tapping the lower aquifer in the most heavily developed areas of the outcrop. (Author's abstract)
W85-06825

TRANSPORT OF ORGANIC COMPOUNDS DISSOLVED IN GROUND WATER,
Tucson Water Dept., AZ.
J. M. Newsom.
Ground Water Monitoring Review, Vol. 5, No. 2, p 28-36, Spring, 1985. 1 Fig, 51 Ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Organic compounds, Transport, Pesticides, Adsorption, Aquifers, Biodegradation, Trace levels, Water analysis, Benzenes, Advection, Dispersion, Groundwater movement.

The transport of organic compounds is diffucult to predict, more so than the flow of groundwater itself, for the following reasons. Trace amounts of pollutants are hard to measure. Transport is complicated if the compound is partitioned into several phases. The concentration of organics in ground water may vary due to aquifer heterogeneity and other hydrologic factors. Reactions with other organic compounds and reactions with the aquifer material may affect the mobility of the organics. Biodegradation may also affect net transport. Transport processes reviewed include advection and dispersion, adsorption and biodegradation. Various chemical groups included in the discussion are halogenated aliphatics, alkyl benzenes, chorobenzenes, and pesticides. While progress has been made in understanding pollutant travel in groundwater supplies, several recommendations are offered for areas that still need research. Some polar organic compounds are not commonly detectable by present methods. In cases where the aquifer may contain sufficient carbon for adsorption to be significant, the empirical relationships that have been developed may be useful for determining the partitioning behavior of organic pollutants. Some elements, such as N, S, or P-compounds, when injected into pollution plumes may promote microbial degradation. More work is also needed to determine how flushing of an aquifer via injection and extraction wells affects those pollutants sorbed onto aquifer or soil material. (Baker-IVI)
W85-06829

DEVELOPING OBJECTIVES FOR THE GROUND WATER QUALITY MONITORING NETWORK OF THE SALINAS RIVER DRAINAGE BASIN,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7A.
W85-06830

ANALYTICAL METHODS FOR THE PREDICTION OF LEACHATE PLUME MIGRATION,
Oklahoma State Univ., Stillwater. Dept. of Geology.
D. C. Kent, W. A. Pettyjohn, and T. A. Prickett.
Ground Water Monitoring Review, Vol. 5, No. 2, p 46-59, Spring, 1985. 9 Fig, 4 Tab, 19 Ref.

Descriptors: *Plumes, *Leachates, *Mathematical models, *Groundwater pollution, Graphical analysis, Prediction, Groundwater movement, Path of pollutants, Computers.

An analytical method developed for predicting leachate movement as part of the evaluation of permit applications dealing with hazardous waste

treatment, storage and disposal facilities can also be used to develop monitoring plans. The methods can be used to estimate or predict what the concentration in a leachate plume might be at some point in space and time. The plume evaluation system is quantitative and is suitable for computer manipulation. The assumptions of the model are: (1) ground water flow regime is saturated, (2) the aquifer is unlimited in areal extent (3) all aquifer properties are homogeneous and isotropic (4) ground water flow is continuous and uniform in direction and velocity. The value or accuracy of the prediction, at best, can be no better than the estimate of the hydrogeologic and chemical parameters that are factored into the equations. (Cutty-IVI)
W85-06831

INVESTIGATIONS AT SITES CONTAMINATED WITH DENSE, NON-AQUEOUS PHASE LIQUIDS (NAPLS),
Pennsylvania Power and Light Co., Allentown. Environmental Management Div.
J. F. Villaume.
Ground Water Monitoring Review, Vol. 5, No. 2, p 60-74, 1985. 15 Fig, 51 Ref.

Descriptors: *Groundwater contamination, *Organic compounds, *Path of pollutants, Fate of pollutants, Water pollution, Hydrocarbons, Density, Unsaturated zone, Saturated zone.

Increasingly, groundwater supplies are being found to be contaminated with organic substances. Depending on the nature of these substances and the method by which they were introduced into the environment, they may form a second, dense liquid phase. Several such cases have been reported in the recent literature. In other cases, such a second phase might have actually been present but was not found because the principles governing its distribution were not understood and no effort was made to look for it. In this case, the undetected material could continue to migrate and act as a source of dissolved organics. The general principles governing the behavior of dense, immiscible second-phase organic liquids in both the unsaturated and saturated zones were reviewed based primarily on the petroleum industry literature for primary hydrocarbon migration and on the oil spill literature. This specialized knowledge can be used to conduct a meaningful and efficient investigation of such contamination sites and can also be used to select and implement successful remedial measures. Several actual case studies applying the principles of multi-phase flows were presented. (Author's abstract)
W85-06832

MODELING FLUID FLOW IN SELECTIVE PLACEMENT OF TOXIC MINE SPOIL,
Pennsylvania State Univ., University Park. Dept. of Mining Engineering.
L. B. Phelps, J. C. Mills, and L. W. Saperstein.
Mining Engineering, Vol. 37, No. 4, p 328-333, April, 1985. 9 Fig, 6 Ref.

Descriptors: *Mine wastes, *Waste disposal, *Water pollution control, *Burial, Finite element method, Water table, Permeability, Drainage, Anisotropy, Infiltration, Model studies, Groundwater movement.

Methods of burial of mine spoil to control environmental damage are not well understood. Using the finite element method, the burial of toxic material is investigated within low permeability packages below the water table. The effects of differing package and spoil permeabilities, anisotropy, and infiltration are modeled to provide information about their effect on the flow system. Projections can then be made that will assist in the design of the toxic spoil package to limit the amount of ground water flowing through them. The experiment was designed to measure the effects of package permeability, higher permeabily basal spoil, anisotropy, and infiltration when using a single densified package. When using a single undensified package surrounded by a low permeability barrier the following parameters were investigated: effect of barrier permeability, effect of increasing package wall thickness, effect of infiltration, and the effect of higher permeability basal spoil. (Baker-IVI)
W85-06839

COMPARATIVE STUDY OF MERCURY CONTAMINATION IN THE TAGUS ESTUARY (PORTUGAL) AND MAJOR FRENCH ESTUARIES (GIRONDE, LOIRE, RHONE),
Ecole Normale Superieure, Paris (France).
G. Figueres, J. M. Martin, M. Meybeck, and P. Seyler.
Estuarine, Coastal and Shelf Science, Vol. 20, No. 2, p 183-203, February, 1985. 9 Fig, 3 Tab, 34 Ref.

Descriptors: *Mercury, *Tagus Estuary, *Portugal, *Gironde estuary, *Loire estuary, *Rhone estuary, *France, *Metals, *Estuarine environment, Heavy metals, Organic mercury, Inorganic mercury, Path of pollutants, Source of pollutants, Sediments, Particle size.

Concentrations of mercury were determined for the waters, suspended matter and sediments of the Tagus and of major French estuaries. The Tagus estuary is one of the most contaminated by mercury derived from the outfalls of a chloralkali plant and from other industrial sources. In deposited sediments the median level, 1.0 micro g Hg/g, is twenty times higher than the natural background and Hg contents depend on the sediment grainsize, age and the distance from waste-outfalls. Suspended matter is more regularly and highly contaminated (median value: 4.5 micro g Hg/g). In the French estuaries Hg levels in the suspended material decrease with salinity due to dilution and/or remobilization processes. In June 1982, in the Loire estuary, high values of Hg were observed in the middle estuary and attributed to urban and industrial sources. In the Tagus estuary, the general distribution of total dissolved Hg confirms the contamination: it increases seaward from 10 ng/l in the river to 80 ng/l in the estuary outlet. The dissolved Hg is almost totally organic in the river, inorganic in the middle estuary due to inorganic Hg effluents and again organic in the lower estuary. This variation is related to the dissolved organic carbon values. The dissolved Hg levels in the Loire Estuary (5-300 ng/l) are much higher than in the Gironde estuary (3-6 ng/l) and of the same order as those observed in the Tagus estuary. (Author's abstract)
W85-06854

BACTERIAL DEGRADATION OF SELECTED ORGANICS IN NATURAL WATERS OF NORTHEASTERN MINNESOTA,
Minnesota Univ.-Duluth. Dept. of Chemistry.
J. Cooley, R. Caple, J. Nichol, and N. Fontaine.
Journal of Great Lakes Research, Vol. 11, No. 1, p 34-39, 1985. 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Biodegradation, *Organic matter, *Minnesota, *Bacteria, Degradation, Chlorinated hydrocarbons, Kinetics, Fate of pollutants, Lipopolysacharides, Epifluorescence counts.

An evaluation of a standardized kinetic procedure that determines the ability of bacteria to degrade organic pollutants was conducted using natural water samples from the Lake Superior watershed in northern Minnesota. Second-order rate constants for the degradation of butoxyethyl and butoxypropyl esters of 2,4-dichlorophenoxyacetic acid, methyl 2,4-dichlorobenzoate, ethyl-2,4-dichlorobenzoate, and p-nitrophenyl ether were determined using three different bacterial enumeration methods. The reproducibility of the bacterial enumeration method is especially important if reliable degradation kinetics are to be obtained. Comparisons of lipopolysaccharide measurements, epifluorescence counts, and standard plate counts to enumerate bacteria suggest bacterial stabilization has a minor, yet notable, effect on kinetic results. (Author's abstract)
W85-06863

CHLORIDE LOADING TO LAKE ONTARIO FROM ONONDAGA LAKE, NEW YORK,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, S. P. Devan, and P. W. Rodgers.
Journal of Great Lakes Research, Vol. 11, No. 1, p 53-58, 1985. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Chloride, *Water pollution sources, *Lake Ontario, *Onondaga Lake, *New York, *Syracuse, *Lake Erie, *Great Lakes, Industrial wastes, Chemical wastes, Path of pollutants, Projections, Pollution load, Chlor-alkali.

Chloride is an often-used indicator of pollution that is generally considered symptomatic of a variety of cultural activities. The recent history of chloride loading to Lake Ontario was investigated in the single largest source, Onondaga Lake, located in metropolitan Syracuse, New York. The mean annual release of chloride from Onondaga Lake was 765,000 metric tons for the period 1970-1981, representing approximately 12% of the total load to Lake Ontario for that period. Approximately 85% of the load from Onondaga Lakes originates from an adjacent chlor-alkali production plant. It is projected that the expected discontinuance of this manufacturing operation will reduce the current chloride levels in Lake Ontario by 1.3 mg/L and the future long-term concentration by 3.2 mg/L. This projection for Lake Ontario is in contrast to the long-term trends predicted for the other four Great Lakes, all of which are expected to experience elevated chloride levels. Thus, in Lake Ontario the reduced loading from Onondaga Lake will more than compensate for the projected increase in loading from the upstream lakes. The new projected steady-state chloride concentration for Lake Ontario will essentially equal the Lake Erie level, reflecting the near equivalence of the future average tributary chloride concentration for Lake Ontario and the input concentration from Lake Erie. (Collier-IVI)
W85-06865

SOURCES OF ACIDIFICATION IN CENTRAL EUROPE ESTIMATED FROM ELEMENTAL BUDGETS IN SMALL BASINS,
Ustredni Ustav Geologicky, Prague (Czechoslovakia).
T. Paces.
Nature, Vol. 315, No. 6014, p 31-36, 2 May 1985. 1 Fig, 7 Tab, 30 Ref.

Descriptors: *Acidification, *Water pollution sources, *Czechoslovakia, *Elbe River, River basins, Sulfates, Agricultural chemicals, Fertilizers, Acid rain.

In order to collect quantitative data on the environmental changes and their rates, an evaluation and comparison was made of mass budgets of H(+), Na, K, L, Mg, Ca, Fe, Al, Si, N-NH4(+), N-NO3(-), C-HCO3(-), Cl, S and P in small hydrologically and geologically well defined drainage basins in the watershed of the Elbe river in Czechoslovakia. Four representative basins considered have similar bedrock, soil and climate conditions but differ in mean slopes and anthropogenic impacts. Comparison of their elemental budgets will help to elucidate the mechanisms that affect the fluxes of elements and cause acidification of soil and water. The data are used to calculate weathering and erosion rates influenced by acid emission and agricultural practice. The elemental budgets in basins affected by industry and agriculture serve as background data for a comparison with representative basins in other regions. Long term increases in acidification of water and soils in the Elbe river basin is caused mainly by the deposition of dry SO2 and the application of industrial fertilizers. The direct input of hydrogen ions by acid rain is less significant. The budgets of elements and protons indicate natural and anthropogenic processes that acidify and buffer the environment. (Baker-IVI)
W85-06874

RESIDUE LEVELS OF ORGANOCHLORINE INSECTICIDES IN SEWAGE PLANT EFFLUENT,
Biological Research Center, Baghdad (Iraq). Dept. of Environmental Pollution.
M. A. Al-Omar, N. H. Al-Ogaily, S. J. Tawfiq, and M. Al-Bassoumy.

Journal of Biological Sciences Research, Vol. 16, No. 1, p 145-151, January, 1985. 1 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Chlorinated hydrocarbons, *Insecticides, *Iraq, *Baghdad, *Diayla river, Fate of pollutants, Water pollution sources, Seasonal variation, Wastewater facilities.

Organochlorine Insecticides (OC) are fairly resistant compounds to biological treatment in sewage plants. Incomplete or imperfect treatment of wastewater containing significant concentrations of these compounds would transfer them to the riverstream through effluent water. The objective of this study is to determine the OC levels in wastewater before and after treatment in the Rustamiya Sewage Treatment Plant which is one of the major plants in Baghdad, Iraq. Samples were collected before and after treatment; residues were extracted by liquid-liquid extraction, cleaned up by Florisil column and detected by electron capture-gas chromatography. Most of the samples taken were found to be contaminated with OC residues and metabolites. Physical and biological processes have little or no effect on the residue levels. The environmental hazard is considered to be low, especially after the dilution of sewage effluent by the Diayla river except in March and April when a case of zero dilution might occur. (Author's abstract)
W85-06875

BIOACCUMULATION AND PARTITIONING OF CADMIUM WITHIN THE FRESHWATER MUSSEL DREISSENA POLYMORPHA PALLAS,
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
R. Bias, and L. Karbe.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 1, p 113-125, 1985. 8 Fig, 3 Tab, 22 Ref.

Descriptors: *Cadmium, *Mussels, *Bioaccumulation, Fate of pollutants, Uptake, Kinetics, Elimination.

Kinetics of uptake, partitioning and elimination of cadmium were investigated in experimental studies with the freshwater mussel, Dreissena polymorpha. A nearly linear increase in cadmium over long periods of time at low level exposure (3.3 micro-g Cd/cu dm) was found. The uptake rates decreased with time during long term experiments with high cadmium concentration in the water (50 micro-g Cd/cu dm). Accumulation factors have consistently been higher in mussels exposed to low concentrations of cadmium. Distinct differences in the affinity of cadmium for the different shell layers and for specific organs were demonstrated. The major portion of cadmium in the soft parts is strongly bound and cannot be eliminated by exchange processes. The shells bound a great deal of cadmium, but only loosely, and the metal could be readily eliminated after transfer to uncontaminated water. (Baker-IVI)
W85-06884

WET DEPOSITION OF CADMIUM, LEAD AND COPPER AT DEONAR (BOMBAY) AND ITS RELATIONSHIP WITH RAINFALL,
Bhabha Atomic Research Centre, Bombay (India). Div of Radiological Protection.
S. C. Ashawa, D. N. Kelkar, and U. C. Mishra.
Water, Air and Soil Pollution, Vol. 25, No. 1, p 63-71, 1985. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Rainfall, *Bombay, *India, *Copper, *Cadmium, *Lead, Wet deposition, Precipitation, Industrial wastes, Water pollution sources, Highways, Petroleum industry, Agricultural chemicals, Monsoons.

A relationship is presented between the wet deposition of trace metals and the amount of rainfall for short term precipitation samples (wet only) collected at Deonar (Bombay) during 1982. The sampling site was the terrace of the BARC Hospital, 16 m above ground, at Deonar. There is a thermal power station, fertilizer plant, and petroleum refineries situated from south to west of the sampling site. Bombay-Poona National Highway is about 500 m away. Rainwater samples collected had pH between 5 and 7. Concentrations of Cd, Pb, and Cu range from 0.05 to 0.2 micro-g/L, 0.35 to 3.2 micro-g/L, and 0.5 to 19.7 micro-g/L, respectively. The wet deposition of Cd, Pb, and Cu for periodic samples is plotted against total rainfall. Size distribution of aerosols at Bombay revealed that 81% of the Pb is associated with particles of size less than 4.7 micro-m and 73% of the Cd is also associated with particles of this size. The half power law relationship shows that the scavenging behavior of these metals associated with fine particles is also similar to that of sulfate. The values for Pd, Cu, and Cd support the use of a power law exponent of 0.6 to describe the relationship between wet deposition of Cd, Pb, and Cu and rainfall amounts. (Baker-IVI)
W85-06888

EVALUATION OF TECHNIQUES TO ESTIMATE ANNUAL WATER QUALITY LOADINGS TO RESERVOIRS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. E. Westerdahl, W. B. Ford, J. Harris, and C. R. Lee.
Technical Report E-81-1, February 1981. Final Report. 61 p, 5 Fig, 18 Tab, 29 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Lakes, *Nonpoint pollution sources, *Pollution load, *Reservoirs, Nitrogen, Phosphorus, Suspended solids, Watersheds, Land use, Sandusky River, Honey Creek, Ohio, Caddo River, Arkansas, Midwest Research Institute technique, National Eutrophication Survey, Instream flow, Sediment yield, Agricultural watersheds, Forest watersheds.

Five techniques for determining annual water quality loadings were compared and evaluated. The techniques included two regional methods (Midwest Research Institute and National Eutrophication Survey) and three instream techniques (average flow, average concentration; flow-weighted concentration; and flow interval). Watersheds used in the study were Sandusky River and Honey Creek, Ohio, (agricultural) and Caddo River, Arkansas (forested). Water quality parameters included were suspended solids, total Kjeldahl nitrogen, and total phosphorus. The regional methods were not adequate for estimating annual water quality loadings to reservoirs. The Midwest Research technique was useful in describing the watershed's physiographic features and hydrologic response characteristics. The National Eutrophication Survey method was applicable only to selected geographical areas. The flow interval method was the only instream flow technique which was statistically valid. It is recommended for estimating annual water quality loadings to reservoirs. However, intensive sampling would be required to account for water quality parameters dependent on season and flow. The average flow, average concentration technique is applicable for water quality constituents that maintain fairly constant concentrations through the range of streamflow. The flow-weighted concentration technique needs data representative of the flow range and runoff water quality characteristic of the watershed.
W85-06908

ANALYSIS OF ISSUES CONCERNING 'ACID RAIN': REPORT TO THE CONGRESS OF THE UNITED STATES.
General Accounting Office, Washington, DC. Office of the Comptroller General.
For primary bibliographic entry see Field 6B.
W85-06944

PHOSPHORUS DYNAMICS IN AN ARKANSAS RESERVOIR: THE IMPORTANCE OF SEASONAL LOADING AND INTERNAL RECYCLING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W85-06964

FIELD SURVEY OF HEAVY METAL UPTAKE BY NATURALLY OCCURRING SALTWATER AND FRESHWATER MARSH PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. W. Simmers, B. L. Folsom, C. R. Lee, and D. J. Bates.
Technical Report EL-81-5, June 1981. Final Report. 155 p, 35 Fig, 17 Tab, 23 Ref, 7 Append.

Descriptors: *Bioaccumulation, *Heavy metals, *Spartina alterniflora, *Cyperus, *Marsh plants, Field tests, Aquatic plants, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Nickel, Manganese, Zinc, Mercury, Baseline studies.

A natural marsh heavy metal survey was conducted to establish a baseline for comparison to plant concentration and uptake data from contaminated and perturbed sediments. Extensive field sampling of natural marshes was conducted along the East and gulf coasts of the United States, and along the shores of the Great Lakes. Spartina alterniflora was collected from the saltwater marshes and Cyperus species were collected from the freshwater marsh areas. In the saltwater, marsh, Mn and Zn concentrations were slightly lower than those previously determined in greenhouse and disposal site studies with contaminated sediments, while the concentrations of the other heavy metals were similar. Calculation of total uptake values indicated that only Cd may be of concern. Cd levels in Cyperus species in naturally occurring marshes were similar to those of a greenhouse flooded (reduced) environment. Fe and Mn were present in lower concentration in the natural marsh than in the greenhouse plants grown on contaminated sediment; the remainder of the heavy metals examined were present in higher concentrations. It is concluded that marsh plants grown on contaminated dredged material in a flooded environment do not bioconcentrate excessive or even significantly higher levels of toxic metals than those same plant species in naturally occurring marshes.
W85-06976

FATE OF CORROSION PRODUCTS RELEASED FROM STAINLESS STEEL IN MARINE SEDIMENTS AND SEAWATER; PART 2: SEQUIM BAY CLAYEY SILT,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
R. L. Schmidt.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82013873. PNL-3466 PT2, April 1982. 26 p. 4 Fig, 10 Tab, 25 Ref. Contract/Grant No. DE-AC06-76RL0-1830.

Descriptors: *Path of pollutants, *Fate of pollutants, *Corrosion, *Sediments, *Silt, *Distribution patterns, Steels, Marine sediments, Aeration, Anoxic conditions, Chromium, Manganese, Iron, Nickel, Copper, Metals.

Laboratory experiments in which neutron-activated 347 stainless steel specimens were exposed to clayey silt from Sequim Bay, Washington are reported. The distributions of Cr, Mn, Fe, Ni and Cu in the Sequim Bay sediment show that diethylenetriaminepentaacetic acid (DTPA) removed < 10% of extractable Cr, Fe and Mn, 20% of extractable Ni and 30% of extractable Cu. The inorganic fraction accounted for 30% of total extractable Mn and 10% or less of Cr, Fe, Ni and Cu. Major portions of Cr and Cu, and a large amount of Fe were in the organic fraction. Extractable Mn, Fe and Ni were associated with hydrous oxides. No Co was detectable in any of the extracts. Neutron-activated 347 stainless steel specimens were exposed to slurries of Sequim Bay clayey silt under aerated and non-oxygenated conditions for a period of 90 days. In aerated sediment the estimated corrosion rate was 6.3 mg/yr/sq cm of stainless steel surface area. Relatively labile substances constituted about half of the 60Co activity released in aerated sediment. Forty-nine % of the 60Co activity was released as, or converted to, relatively inert substances, requiring rigorous treatment to dissolve. The distribution of 60Co released to anoxic Sequim Bay clayey silt showed that relatively labile substances constituted 95% of the 60Co released. In the absence of O2 the association of

60Co with the refractory (oxidic) fraction was inhibited only 5% of the 60Co activity was in relatively inert forms.
W85-06981

BEHAVIOUR OF CRUDE OIL SPILLED UNDER MULTI-YEAR ICE,
ARCTEC Canada Ltd., Kanata (Ontario).
G. Comfort, and W. Purves.
EPS 4-EC-82-4, August 1982. Environment Canada, Environmental Protection Service, Ottawa (Ontario). 76 p, 9 Fig, 8 Tab, 6 Ref, 3 Append.

Descriptors: *Oil, *Ice cover, Evaporation, Clean-up, Oil spills, Cold regions.

In June 1978, 1.8 cu m of Norman Wells crude oil was discharged at three locations under a multi-year ice cover in Griper Bay, Northwest Territories. A site investigation was carried out during September 1979 to determine the fate of the spilled oil. The three sites were cored and drilled and the quantity of the oil remaining in the ice sheet was estimated. Samples of surface oil and oil within the ice sheet were collected and analyzed to obtain estimates of the amount of weathering the oil had undergone. Only a small amount of the oil which was originally discharged was still remaining in the ice sheet. A maximum of 10% of the oil originally discharged was found in the ice sheet at one site, while the other two sites had only 1% and none of the oil remaining. Oil on the ice surface was severely weathered with an average weight loss (by evaporation) of > 42%. The oil had migrated horizontally within the ice sheet as well as vertically. The test sites still containing oil within the ice sheet had experienced a 400% increase in area of contamination over that originally occupied by the initial discharge. The test site was relatively free of oil and it appeared that the natural processes of dispersion and evaporation had been relatively effective in cleanup.
W85-06987

METHODOLOGY FOR OVERLAND AND IN-STREAM MIGRATION AND RISK ASSESSMENT OF PESTICIDES,
Battelle Pacific Northwest Labs., Richland, WA.
Y. Onishi, S. M. Brown, A. R. Olsen, M. A. Parkhurst, and S. E. Wise.
EPA-600/3-82-024, May 1982. Environmental Research Laboratory, Athens, GA. 205 p, 61 Fig, 10 Tab, 44 Ref, 3 Append. Contract/Grant No. 68-03-2613.

Descriptors: *Computer models, *Nonpoint pollution sources, *Pesticides, *Agricultural runoff, *Water pollution effects, *Fish, *Decision making, *Fate of pollutants, Models, Simulation analysis, Land management, Model studies, Aquatic animals, Toxicity, Water pollution control.

The CMRA (Chemical Migration and Risk Assessment) Methodology was developed to predict the occurrence and duration of pesticide concentrations in surface waters receiving runoff from agricultural lands and to assess potential acute and chronic damages to aquatic biota. The CMRA Methodology uses the ARM and SERATRA models to continuously simulate nonpoint source pollution processes. The risk assessment procedure of the model coupled with the FRANCO computer program provides a good scientific basis for pesticide risk assessment of the direct effects of dissolved pesticide concentrations on aquatic biota. The CMRA Methodology was used to evaluate the migration and fate of alachlor and toxaphene, and their potential acute and chronic impacts on fish in the Four Mile Creek Watershed (Iowa). Results showed that the CMRA Methodology is capable of predicting rate and effects of pesticides for a wide range of compounds, agricultural lands, receiving streams, and aquatic biota. The fitting of overland and instream pesticide concentrations with statistical distributions did not prove feasible because an excessive number of simulations would be required. The CMRA Methodology will provide researchers with a way to evaluate the relative importance of various mechanisms that control transport and fate phenomena occurring on watersheds and in receiving streams.
W85-06989

PROCEEDINGS OF STORMWATER AND WATER QUALITY MODEL USERS GROUP MEETING: JANUARY 27-28, 1983.
Environmental Protection Agency, Athens, GA.
For primary bibliographic entry see Field 5G.
W85-06999

SIGNIFICANCE OF SOLVATION PHENOMENA FOR THE PARTITION OF HALOGENATED ORGANIC COMPOUNDS BETWEEN WATER AND A PARAFFINIC PHASE (DIE BEDEUTUNG DER SOLVATATION FUR DIE VERTEILUNG VON HALOGENORGANISCHEN VERBINDUNGEN ZWISCHEN WASSER UND EINER PARAFFINPHASE),
Essen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich Chemie.
For primary bibliographic entry see Field 2K.
W85-07024

POLLUTION OF TWO STREAMS IN A RURAL REGION - A COMPARISON BY INVESTIGATIONS OF SEVERAL YEARS (VERGLEICH DER BELASTUNG ZWEIER BACHE IM LANDLICHEN RAUM ANHAND MEHRJAHRIGER UNTERSUCHUNGEN),
Giessen Univ. (Germany, F.R.). Inst. fuer Mikrobiologie und Landeskultur.
W. Sussmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 18, No. 2, p 56-66, April, 1985. 5 Fig, 5 Tab, 14 Ref.

Descriptors: *Fate of pollutants, *Klingebach stream, *Reiherbach stream, *Germany (Federal Republic), *Waldeck-Sachsenhausen, *Self-purification, Ammonia, Organic matter, Sodium, Potassium, Chloride, Water temperature.

Since 1975 water quality investigations have been carried out at two streams north of Edersee reservoir (Federal Republic of Germany). The Klingebach stream (drainage basin: 8.8 sq km) is polluted by the waste water clarification plant of the little town Waldeck-Sachsenhausen (1850 inhabitants), while the Reiherbach stream (drainage basin: 16.7 sq km) is only influenced by the waste water of a little village with 100 inhabitants. In both streams the concentrations of phosphorus compounds, ammonia, organic substances, sodium, potassium and chloride are markedly higher than those in their unpolluted tributaries. Great differences in concentrations exist between both streams, corresponding to the wastewater pollution. However, along a reach of approx. 3 km in both streams a noticeable self-purification can be observed; the influence of temperature is evident. (Author's abstract)
W85-07025

EXPERIMENTAL STUDY OF BLUFF SURFACE DISCHARGES WITH SMALL RICHARDSON NUMBER,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam.
Journal of Hydraulic Research, Vol. 23, No. 1, p 47-55, 1985. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Diffusion, *Turbulent flow, *Jets, *Bluff surface discharge, Richardson numbers, Outfall, Heated water, Discharge hydrographs.

An experimental study was conducted on the near field diffusion of bluff buoyant turbulent surface jets with small (source) Richardson number in a large body of water without any ambient currents. The velocity scale decreases inversely with the axial distance, x, from the outfall whereas the vertical and surface length scales h and b grow linearly with x. The variation of the coefficients in the relations for these scales, with the source Richardson number has been evaluated using the experimental observations. Based on these observations made with Richardson number in the range of 0.002 to 0.091, the following conclusions were formulated. The velocity scale in terms of the velocity at the outfall varies inversely with the area of cross section of outfall/axial distance from outfall with the coefficient varying with the 1/10th power of the Richardson number at source. The vertical length scale, h, in the central plane increases linearly with x, the distance from the outfall, with the slope dh/dx decreasing strongly with the Richardson number at source, falling to almost zero when the source Richardson number approximately equals 0.1. The horizontal length scale, b, at the water surface increases linearly with x with the rate of increase db/dx increasing gradually with increasing Richardsons number at source. Further the velocity profiles in the centerplane and at the surface have been found to be similar. (Baker-IVI)
W85-07032

ESTIMATING NONPOINT POLLUTION FROM SMALL URBAN WATERSHEDS,
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
V. Novotny, H.-M. Sung, R. Bannerman, and K. Baum.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 339-348, April, 1985. 10 Fig, 6 Tab, 24 Ref.

Descriptors: *Urban runoff, *Nonpoint pollution sources, *Urban watersheds, Model studies, Street sweeping, Suspended solids, Nitrogen, Roads, Computer models.

The Milwaukee project was one of 28 Nationwide Urban Runoff Program (NURP) projects conducted in the United States. Modeling pollution accumulation on steel surfaces and the quality and quantity of runoff are investigated. In the Milwaukee NURP project, street refuse deposition, traffic emissions on roadways with a high traffic density, and urban erosion contributed the largest mass of pollutants to urban runoff. Wet and dry deposition were not as significant, except for nitrogen loads. The pollution accumulation on street surfaces generally follows a decreasing rate-of-increase model. The magnitude of the removal coefficient can be related to the traffic volume, traffic speed, and wind speed above a certain threshold value. The magnitudes of the removal coefficient for the experimental watersheds in this study ranged from 0.2 to 0.3/day. A statistical comparison of pollutant concentrations in the runoff from test and control sites showed a very small, statistically unrecognizable effect of street sweeping on pollution loads. Efficiency of street sweepers was generally low, and street-sweeping efficiency was often negative at low street solids loads. Simulated loadings by a computer model confirmed the findings. Loadings and concentrations in the runoff, estimated by the model for the swept and unswept sites, were not different in a watershed with imperviousness of less than 80%. (Baker-IVI)
W85-07055

EMERGENCY: INTRUSION OF PROPANE INTO WATER MAINS,
Bridgeport Hydraulic Co., CT.
For primary bibliographic entry see Field 5F.
W85-07063

SLOW-ZONE MODEL FOR LONGITUDINAL DISPERSION IN TWO-DIMENSIONAL SHEAR FLOWS,
Nigeria Univ., Nsukka. Dept. of Mechanical Engineering.
S. C. Chikwendu, and G. U. Ojiakor.
Journal of Fluid Mechanics, Vol. 152, p 15-38, March, 1985. 5 Fig, 21 Ref.

Descriptors: *Mathematical models, *Dispersion, *Path of pollutants, *Shear flows, Turbulent flow, Open channel flow, Differential equations, Mixing, Diffusivity, Spatial distribution.

One problem with the one-dimensional model for the longitudinal dispersion of contaminants in turbulent flow in open channels always predicts a normal distribution of matter down the channel for all time, whereas observed distributions of dispersing clouds are always skewed, especially at small times. A partial-differential-equation approach is proposed to explain the skewed profile by means of

a two-zone model. The flow is divided into a fast zone and a slow zone which interact while each zone is governed by a linear one-dimensional dispersion equation. The usual one-dimensional dispersion approach is used in each zone, but with different flow speeds and dispersion coefficients in the fast and slow zones. Turbulent vertical mixing is allowed at the interface between the two zones, with a small vertical diffusivity. This leads to a pair of coupled, linear, one-dimensional dispersion equations, which are solved by Fourier transformation. The Fourier-inversion integrals are analyzed using two different methods. In the first method asymptotically valid expressions are found using the saddle-point method. The peak value of the average concentration decays exponentially with time at a rate which is close to the rate observed in the early stage of the dispersion process. The solution is useful for fairly small times. In the second method an exact solution is found in the form of a convolution integral. Explicit expressions which are valid for small times and for large times from the release of contaminant are found. For small times this exact solution confirms the basic results obtained by the saddle-point method. For large times the exact solution gives a contaminant concentration which approaches a Gaussian distribution travelling with the bulk speed as predicted by the Taylor model. The overall longitudinal dispersion coefficient at large times consists of the diffusivity D0 plus a contribution which depends entirely on the vertical mixing. (Moore-IVI)
W85-07083

CONTAMINANT DISPERSION AS VIEWED FROM A FIXED POSITION,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol. 152, p 217-233, March, 1985. 8 Fig, 13 Ref.

Descriptors: *Dispersion, *Spatial distribution, *Mathematical equations, Path of pollutants, Flow, Fate of pollutants.

A Hermite series expansion is used to describe the time evolution of the contaminant concentration at a fixed location in a flow. Exact expressions are derived for the dosage, centroid and temporal variance. A two-mode approximation is proposed which gives accurate results at moderate to large distances downstream of the discharge. This work, along with some others, demonstrates how temporal moments can be used in numerical predictions, in the analysis of field data, and to obtain exact analytic results. On all accounts the temporal approach is of similar complexity, and hence is a genuine alternative to the longer-established spatial approach to contaminant dispersion. One facet of the exact analysis is that it can provide canonical examples for the testing of numerical methods. More substantially, the exact form of solutions can give valuable insight for the qualitative understanding of the dispersion process, and towards the development of efficient approximation schemes. (Baker-IVI)
W85-07084

ANATOMY OF A GROUNDWATER CONTAMINATION EPISODE,
Haifa Univ. (Israel). Dept. of Economics.
M. Shechter.
Journal of Environmental Economics and Management, Vol. 12, No. 1, p 72-88, March, 1985. 1 Fig, 4 Tab, 29 Ref.

Descriptors: *Price Landfill, *New Jersey, *Groundwater pollution, *Cost analysis, Landfills, Public health, Mortality, Aquifers, Damages, Water pollution control.

Using the contamination episode at Price Landfill, New Jersey, as a case study, major analytical and informational issues characterizing groundwater pollution are addressed with special emphasis on uncertainty associated with the environmental medium, especially solute-transport processes, and the valuation of health risks, principally dose-response relationships. Alternative approaches to modeling the physical-chemical processes are described and subsequently coupled with mortality risk predictions to derive estimates of expected polution costs: reduced longevity (pollution damage costs) and cost of control and remedial measures (damage reduction costs). Price Landfill is a 22 acre site situated on the Cohansey aquifer which is 210 to 245 ft deep. It operated as an active waste disposal site from 1068 until about 1976, and received significant quantities of chemical and liquid waste. Atlantic City draws its water from this aquifer. Various models were constructed of the landfill in order to understand more fully and accurately the obvious spread of contamination from the landfill through the groundwater. The conclusiveness of the damage valuation thus made is considered. (Baker-IVI)
W85-07090

COLIPHAGE SURVIVAL IN SEAWATER,
Malaga Univ. (Spain). Dept. of Microbiology.
J. J. Borrego, and P. Romero.
Water Research, Vol. 19, No. 5, p 557-562, 1985. 5 Fig, 1 Tab, 35 Ref.

Descriptors: *Coliphages, *Water quality control, *Indicator organisms, Viral analysis, Viruses, Water analysis, Bacteriophages.

The relative survival of coliphages isolated from seawater under controlled conditions in different media, in the lab and in the marine environment, was investigated. In experiments carried out under lab conditions in seawater, suspensions of the viruses in treated seawater were incubated at 18 C and their inactivation rates followed. The inactivations of coliphages H55 and S1 were slight and similar, whereas bacteriophage V2 showed anomalous resistance to inactivation. After 360 days all coliphage activities were practically nil. In determining the effects of different biotic factors, the bacteriophage concentration decreased markedly in natural clean seawater, whereas in clean seawater sterilized by autoclaving and subsequent membrane filtration, and in sterile distilled water, titers remained constant 50 days after sampling. In tests of the dispersion and survival of the coliphages in natural seawater, the initial coliphage titer of 1:10 survived 2.4 min, whereas the higher ratios, 1:100 and 1:1000, lasted 11.4 and 84 min, respectively. Coliphages T-90 values varied between 10.8 and 18.33 min, the average was 13.7 min. Disappearance of the coliphage titer in the sea took place between 112 and 121 min, depending on the host bacterial strain used for their detection. (Baker-IVI)
W85-07114

BIOTRANSFORMATION OF TETRACHLOROETHYLENE TO TRICHLOROETHYLENE, DICHLOROETHYLENE, VINYL CHLORIDE, AND CARBON DIOXIDE UNDER METHANOGENIC CONDITIONS,
Stanford Univ., CA. Dept. of Civil Engineering.
T. M. Vogel, and P. L. McCarty.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1080-1083, May, 1985. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Biotransformation, *Vinyl chloride, *Dichloroethylene, *Tetrachloroethylene, *Trichlorethylene, *Fate of pollutants, Methanogenesis, Carcinogens, Public health, Industrial wastes, Solvents, Toxicity.

Widespread contamination of groundwater by halogenated compounds has led to investigations to determine their fate in the environment. The study confirms that tetrachloroethylene (PCE) can be transformed by reductive dehalogenation to trichlorethylene (TCE), dichloroethylene and vinyl chloride (VC) under anaerobic conditions. PCE was at least partially mineralized to carbon dioxide as well. Mineralization of 24% of the PCE occurred in a continuous flow fixed film methanogenic column with a liquid detention time of 4 days. TCE was the major intermediate formed, but traces of dichloroethylene isomers and VC were also found. In other column studies under a different set of methanogenic conditions, nearly quantitative conversion of PCE to VC was found. These studies clearly demonstrate that TCE and VC are major intermediates in PCE biotransformation under anaerobic conditions and suggest that potential exists for the complete mineralization of PCE to carbon dioxide in soil and aquifer systems and in biological treatment processes. (Baker-IVI)
W85-07127

EFFECT OF TEMPERATURE, PH, AND OXYGEN LEVEL ON THE MULTIPLICATION OF NATURALLY OCCURRING LEGIONELLA PNEUMOPHILA IN POTABLE WATER,
Pittsburgh Univ., PA. Graduate School of Public Health.
R. M. Wadowsky, R. Wolford, A. M. McNamara, and R. B. Yee.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1197-1205, May, 1985. 5 Fig, 2 Tab, 33 Ref.

Descriptors: *Legionella, *Water temperature, *Hydrogen ion concentration, *Dissolved oxygen, *Potable water, Bacteria, Water analysis, Public health, Temperature effects, Water quality control, Anaerobic conditions.

The plumbing systems of large buildings may frequently be contaminated with Legionella pneumophila. The occurrence of L. pneumophila in plumbing systems raises questions concerning the growth and survival of the organism in potable water. A method has been developed for the preservation of naturally occurring L. pneumophila and associated microbiota in the laboratory. Maintenance of the water culture depended upon transferring the culture when the growth of L. pneumophila was in the late-exponential to early-stationary phase. The results of studies on the multiplication of L. pneumophila indicate that multiplication in aquatic environments may occur between 25 and 45 degrees C and at pH values of 5.5 to 9.2. Although multiplication of L. pneumophila does not occur under relatively anaerobic conditions, prolonged survival may occur. Water stock cultures may be useful in delineating symbiotic relationships which may exist between L. pneumophila and other microorganisms. (Baker-IVI)
W85-07128

TRACE-METALS AND CHLORINATED HYDROCARBONS IN BIRDS' EGGS FROM THE DELTA OF THE DANUBE,
Dipartimento di Biologia Ambientale, Univ. de Siena, Italy.
C. Fossi, S. Focardi, C. Leonzio, and A. Renzoni.
Environmental Conservation, Vol. 11, No. 4, p 345-350, Winter, 1984. 1 Fig, 4 Tab, 23 Ref.

Descriptors: *Trace elements, *Chlorinated hydrocarbons, *Danube River, *Deltas, *Birds, *Eggs, Polychlorinated biphenyls, Chemical analysis, Pesticides, DDT, Mercury, Selenium, Cadmium, Lead, Lindane.

The levels of some common persistent contaminants (trace elements and chlorinated hydrocarbons) in the birds of the Danube Delta were investigated. Eggs were examined from the following species: white pelican, common cormorant, pygmy cormorant, glossy ibis, grey heron, night heron, and mallard. Of the trace elements sought (Hg, Se, Cd, and Pb) cadmium and lead occurred in very low concentrations. Mercury reached high levels in predatory birds (4.9 mm in the common cormorant). Selenium concentrations were quite high but homogeneous in the different species. No correlation between selenium and mercury concentrations was found, suggesting that the possible protective action of selenium enters into effect only when a certain threshold of mercury concentration has been reached. DDTs occurred at very high levels in the first three species. PCB levels were lower with the PCB/DDE ratio being about 0.3 to 0.8. Lindane was present in amounts greater than those found in the Mediterranean and in the East Atlantic; alpha-HCH and HCB levels were similar to those found in these other areas. (Baker-IVI)
W85-07146

ARSENIC IN THE DUNLIN (CALIDRIS ALPINA) FROM THE DUTCH WADDENZEE,

Interuniversitair Reactor Inst., Delft (Netherlands).
A. A. Goede, and M. de Bruin.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 617-622, May, 1985. 3 Fig, 7 Ref.

Descriptors: *Arsenic, *Waddenzee, *Netherlands, *Dunlin, Birds, Metals, Estuaries, Water pollution effects, Feathers.

The Waddenzee is a large estuarine area in The Netherlands, which has an important significance in the life cycle of waders. The area is severely polluted by the rivers Rhine and Scheldt. In the Waddenzee, the arsenic concentration was found to be higher in feathers of adult birds in this area than in juvenile feathers formed on the remote breeding grounds. In birds collected while migrating in Sweden, arsenic kidney concentrations were all below detectable limits of 0.35 mg/kg. For seven out of eight birds collected in the Western part of the Waddenzee shortly after arrival, the kidney concentrations were already elevated. In October a mean value of nearly 6.6 mg/kg was reached. For juveniles, with the exception of one sample, all primary vane concentrations were below 1.0 mg/kg. For the adults, all vane concentrations except three were above 10 mg/kg, as is a non-essential trace element which concentration is not internally controlled. Relatively high As liver concentrations can be expected for Dunlins from the Dutch Waddenzee. (Baker-IVI)
W85-07148

CHANGES IN THE SULFIDE CONTENT OF BOTTOM MUDS IN GOING FROM RIVER TO SEA,
Hiroshima Univ. (Japan). School of Medicine.
Y. Hiraoka, and H. Okuda.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 623-626, May, 1985. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Sulfides, *Bottom sediments, *River mouth, *Ohta River, *Hiroshima Bay, *Japan, River beds, Mud, Water pollution sources, Sulfates.

Water is usually analyzed chemically with little attention to bottom mud content when determining the level of pollution in rivers and the sea. At 10 sampling locations on the Ohta River and Hiroshima Bay, low tide muds were collected with a scoop for total sulfide determination. Total sulfide content in the bottom muds of Stations 1 and 2 were 0.051 mg/kg dry mud and ND, respectively. Station 1 was a fresh water zone and Station 2, a tidal zone. There was a low amount of organic matter at each of these two stations. Total sulfide content gradually increased from 0.58 to 1.7 mg/g dry mud at Stations 3, 4, 5, and 6. In these water areas the concentration of sulfate was always greater as a result of the mixing of river and sea water, which contains 2560 ppm sulfate on the average. At Stations 7, 8, 9, and 10 total sulfide gradually decreased from 0.74 to 0.098 mg/g dry mud. At these stations sulfates and sulfate-reducing bacteria are sufficiently present for sulfide production to occur in proportion to the quantity and quality of the organic matter. The production of sulfides therefore was highest in the muds of the river mouth. The mud of such water is apt to be polluted and have an adverse influence on water with which it comes into contact. (Baker-IVI)
W85-07149

NATIONAL CONTAMINANT BIOMONITORING PROGRAM: CONCENTRATIONS OF SEVEN ELEMENTS IN FRESHWATER FISH, 1978-1981,
Fish and Wildlife Service, Columbia, MO.
T. P. Lowe, T. W. May, W. G. Brumbaugh, and D. A. Kane.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 363-388, May, 1985. 1 Fig, 8 Tab, 23 Ref, 1 Append.

Descriptors: *Fish, *Lead, *Mercury, *Cadmium, *Arsenic, *Selenium, *Copper, *Zinc, Heavy metals, Monitoring, Water pollution effects.

As a continuing part of the National Contaminant Biomonitoring Program, the U.S. Fish and Wildlife Service collected freshwater fish at 112 monitoring stations in 1978-1979 and 1980-1981. Three composite samples of three to five fish were collected at each of about half of the stations in odd-numbered years and at the other half in even-numbered years, and analyzed for lead, mercury, cadmium, arsenic, selenium, copper, and zinc. The geometric means, minimum, and maximum of elemental concentrations (micro-g/g wet weight) during 1978-1979 and (in parentheses) during 1980-1981 were as follows: Pb 0.19, 0.10-6.73 (0.17, 0.10-1.94); Hg 0.11, 0.01-1.10 (0.11, 0.01-0.77); Cd 0.04, 0.01-0.41 (0.03, 0.01-0.35); As 0.16, 0.04-2.08 (0.14, 0.05-1.69); Se 0.46, 0.09-3.65 (0.47, 0.09-2.47); Cu 0.86, 0.29-38.75 (0.68, 0.25-24.10); and Zn 25.63, 7.69-168.1 (23.82, 8.82-109.2). The 85th percentile, calculated for station mean concentrations (micro-g/g wet weight) for 1978-1979 and 1980-1981, respectively, were: Pb 0.32 and 0.25; Hg 0.18 and 0.18; Cd 0.09 and 0.06; As 0.23 and 0.22; Se 0.70 and 0.71; Cu 1.14 and 0.90; and Zn 46.26 and 40.09. There was no significant upward or downward trend between collection periods of the national geometric means of any of the elements except for copper which decreased significantly. Species differences in elemental concentrations contributed more variability to the data set than did station differences. The proportion of the collections composed of each species changed little between collection periods. Thus, the magnitude of the species effect on the national geometric mean of each period was probably fairly consistent; however, it precludes one making sound comparisons among various regions of the United States. (Author's abstract)
W85-07161

5C. Effects Of Pollution

PORT SOLVES ENVIRONMENTAL PROBLEMS,
Port of Long Beach, CA.
G. Knatz.
Journal of Environmental Health, Vol. 47, No. 5, p 233-240, March/April, 1985. 13 Fig, 10 Ref.

Descriptors: *Ports, *Long Beach, *California, Ships, Water pollution control, Hazardous materials, Oil spills, Air pollution, Monitoring, Ballast water, Waste disposal.

Vessel activity in the busiest United States port on the West Coast requires specialized solutions to environmental problems. This activity can result in discharges of ballast water, accidental oil spills and the generation of shipboard garbage, all of which require specialized monitoring and treatment. Over its 70 years of growth, the Port of Long Beach, California developed in increments, sometimes without regard to compatibility of surrounding land uses. A shift in focus occurred after the water quality problems of the 1950's were solved, to emphasis on localized air pollution problems and risks inherent in storing and handling large quantities of hazardous materials. Developing facilities to ship large amounts of western U.S. coal to the Far East and resolving conflicts between neighboring auto import dealers and a coke calcining facility are two examples of port involvement in reducing the impact of localized air pollutants. Procedures now exist for siting new port facilities that handle or store large quantities of hazardous materials to reduce the risks of exposure to surrounding personnel and facilities. (Author's abstract)
W85-06176

RESPONSE OF PLANKTONIC AND MICROBENTHIC ALGAL ASSEMBLAGES TO NUTRIENT ENRICHMENT IN SHALLOW COASTAL WATERS, SOUTHWEST SWEDEN,
Lund Univ. (Sweden). Dept. of Marine Botany.
For primary bibliographic entry see Field 2L.
W85-06210

EFFECTS OF WATER QUALITY AND WATER QUANTITY ON NUTRITIONAL STATUS: FINDINGS FROM A SOUTH INDIAN COMMUNITY,
United Nations Children's Fund, Kampala (Uganda).
J. R. Hebert.
Bulletin of the World Health Organization, Vol. 63, No. 1, p 143-155, 1985. 3 Fig, 5 Tab, 36 Ref.

Descriptors: *Public health, *Water quality, *Water supply, *India, Drinking water, Bacteria, Nutrition, Sanitation, Children, Developing countries.

Data were collected concerning the nutritional status of 627 children in three urban communities in South India. Information was also collected on water quality, water quantity, household sanitation, socioeconomic conditions and housing. A statistical technique is presented that allows for controlling potential confounding factors in the analyses. For children aged 3 years or older the findings of this study are consistent with the notion that water quantity is a relatively stronger determinant of child health than in water quality. For younger children, however, the data support the opposite view. That is, for children under 3 years of age, water quality tends to be a stronger predictor of nutritional status than either washing- or cooking/drinking-water volume or availability. (Baker-IVI)
W85-06216

RESPONSES OF MODEL FRESHWATER ECOSYSTEMS TO CRUDE OIL,
Texas Univ. Health Science Center at San Antonio. School of Public Health
M. D. Werner, V. D. Adams, V. A. Lamarra, and N. L. Winters.
Water Research, Vol. 19, No. 3, p 285-292, 1985. 8 Fig, 7 Tab, 31 Ref.

Descriptors: *Water pollution effects, *Oil spills, *Lakes, Ecological effects, Crude oil, Oxygen demand, Nutrients, Toxicity, Productivity, Aquatic plants, Hydrocarbons.

Petroleum hydrocarbon stimulated the activity of the decomposer community immediately following the addition of crude oils to model freshwater ecosystems. Major effects of this on the overall ecosystems included: lower oxygen conditions, increased nutrient (nitrate and phosphate) utilization and a shift from an autotrophically to heterotrophically dominated diurnal ecosystem. Crude oil led to low oxygen condition in these experiments in at least three ways. First, a high oxygen demand was placed on the ecosystems because of biological degradation of petroleum hydrocarbons. Secondly, oil caused a reduction in primary production due to initial toxic inhibition and ongoing nutrient limitation. Thirdly, an oil film at the water surface apparently reduced the oxygen diffusion across the air-water interface. Unweathered oil caused a significant reduction in the growth of Selenastrum capricornutum due to toxic effects, but oil weathered for 48 days in an aqueous medium did not inhibit growth. The research indicates toxic effects of crude oil on plants in freshwater ecosystems will not be as harmful as oxygen and nutrient demand placed on a system by remaining oil. Cleanup efforts should reflect these potential impacts, efforts should be made to continue to remove as much oil from a site as possible, even after toxic effects have subsided. (Baker-IVI)
W85-06219

LAKE ALGAL POPULATIONS AND PHYSICO-CHEMICAL CHANGES AFTER 14 YEARS INPUT OF METALLIC MINING WASTES,
Victoria Univ. (British Columbia). Dept. of Biology.
A. Austin, J. Deniseger, and M. J. R. Clark.
Water Research, Vol. 19, No. 3, p 299-308, 1985. 6 Fig, 2 Tab, 39 Ref.

Descriptors: *Mine wastes, *Algae, *Water pollution effects, *Buttle Lake, *British Columbia, Lead, Zinc, Copper, Nutrients, Heavy metals, Periphyton, Phytoplankton, Species diversity, Acid mine drainage.

A primarily lead-zinc-copper mine operating since May 1967 has continuously discharged heavy metal mine tailings into the south basin of Buttle

Lake (British Columbia). Sampling of this previously undisturbed, wilderness park lake, during initial activities in 1966-1968 and again in 1980-1982 has indicated a pattern of change. Nutrient levels have remained stable while concentrations of heavy metals have greatly increased. This increase is largely due to acid generation and metals release to groundwater. Species of both periphyton and phytoplankton, known to be sensitive to heavy metals, have dramatically decreased in abundance. Other more tolerant forms such as Navicula cryptocephala, Synedra acus, Synedra filiformis and Cyclotella bodanica have subsequently increased in quantity. Additionally, species number and diversity have decreased throughout the lake while near the source of tailings effluent cell density was substantially lower. (Author's abstract)
W85-06221

TOXIC EFFECTS OF PETROLEUM AND SHALE JP-4 AND JP-8 AVIATION FUELS ON FATHEAD MINNOWS,
Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH.
J. W. Fisher, T. P. Hunt, M. E. Putnam, and M. J. Livingston.
Water Resources Bulletin, Vol. 21, No. 1, p 49-52, February, 1985. 2 Tab, 11 Ref.

Descriptors: *Fuel, *Shale oil, *Toxicity, *Fathead minnows, Hydrocarbons, Fish, Water pollution effects, Oil spills.

Static 96-hour median lethal concentrations were determined for the water-soluble fraction (WSF) of both petroleum-derived and shale-derived aviation fuels (JP-4 and JP-8) using fathead minnows. JP-8 was more toxic than JP-4 except for one shale JP-4 sample that was as toxic as the JP-8. Petroleum and shale JP-8 were similar in toxicity. The toxicity of shale JP-4 was less clear. Shale JP-4 from three vendor sources revealed differing toxicity values. One shale JP-4 sample was more toxic and one less toxic than its petroleum analogue, with the third being equally toxic. Toxicity of the fuels may be enhanced by compounds in the WSF that correspond to chemicals containing 10 or more carbon atoms. (Author's abstract)
W85-06238

WATER POLLUTION - PHYCOLOGICAL PERSPECTIVES,
Banaras Hindu Univ., Varanasi (India). Centre for Advanced Study in Botany.
J. P. Gaur, and L. C. Rai.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 375-389, 1983. 2 Tab, 75 Ref.

Descriptors: *Water pollution effects, *Algae, Species diversity, Food chain, Heavy metals, Synergism, Bioaccumulation, Biological wastewater treatment, Adaptation.

Water pollution exerts selection pressure on algal populations. In spite of a possible adaptation, often a changed diversity and sociological structure result, from which other effects on higher levels of the nutrient chain may emanate. A table represents some biological indices for characterizing algal communities which may serve as a biological measure of pollution and self-purification, the problem of diversity being especially taken into account. Moreover, algal tests are used for representing the trophic situation and for determining the limiting nutrient, but also for determining the toxic influencing of biocenosis by hydrocarbons. Special attention is paid to heavy metals with regard to their synergistic action and bioaccumulation. On the other hand, the mass culture of algae is a valuable method of wastewater treatment and the recovery of valuable materials, and algae ponds provide an important technique for advanced wastewater purification. (Author's abstract)
W85-06266

CUMULATION OF ZINC, CADMIUM AND MERCURY ON THE ALGA SCENEDESMUS OBLIQUUS,
Ceske Vysoke Uceni Technicke v Praze. Fakulta Jaderna a Fysikalne Inzenyrska.
J. Stary, B. Havlik, K. Kratzer, J. Prasilova, and J. Hanusova.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 401-409, 1983. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Zinc, *Cadmium, *Mercury, *Algae, *Bioaccumulation, Heavy metals, Radioisotope tracers, Cumulation factor, Hydrogen ion concentration.

The cumulation factor F (the ratio of the concentration of metal in algal cells and in the medium) depends on the species of algae, on the type of metal, its chemical form, concentration, etc. In batch experiments with the radionuclide labeled metals, the cumulation of zinc, cadmium and mercury on Scenedesmus obliquus is measured in relation to pH, because the original pH-value of the solution is changed by the algae due to their absorption of hydrogen ions. For the uptake of zinc and cadmium the logarithm of the cumulation factor in the range of 2-5 is a linear function of the pH in the range of 5-9, cumulation increasing with rising pH. In contrast, mercury cumulation is pH-independent. If the change in pH is taken into account, the cumulation factors are independent of the metal concentration in the range to 0.0001 mol/l. The degree of cumulation is not changed by the presence of other metals. The cumulation factor is reduced by substances forming negatively charged complexes with metals. In the presence of potassium bromide or iodide, the cumulation of mercury decreases because of the formation of negatively charged complexes; the decrease is not directly proportional to the equilibrium concentration of the bromide or iodide. (Moore-IVI)
W85-06268

SHORT TERM EFFECTS OF ALDRIN AND SWASCOFIX CD-38 ON THE FEEDING AND RESPIRATORY BEHAVIOURS OF CLARIAS BATRACHUS AND CIRRHINA MRIGALA,
Punjabi Univ., Patiala (India). Dept. of Zoology.
A. K. Gupta, S. S. Dhillon, I. P. Tonk, and S. R. Verma.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 423-432, 1983. 5 Fig, 18 Ref.

Descriptors: *Aldrin, *Swascofix CD-38, *Fish behavior, *Feeding, *Respiratory rate, *Toxicity, Insecticides, Surfactants, Behavior, Water pollution effects.

Fish were kept in non-toxic water or at 0.5, 0.25, and 0.125 of the 96h LC50 of the tenside or insecticide for 24 h and fed with toxified and non-toxified feed. Toxified feed in normal water resulted in maximum feed intake, while normal feed in toxified water result in a minimum one. In each case, the feed intake was lower compared with the control, and the feed intake was inversely proportional to the toxicant concentration. In a simple respirometer the oxygen consumption in mg/kg/h was tested for 1, 2, 4, 6, 8, 10, 12, 24, 36, 48, 60, 72, 84 and 96 h of exposure to 1.5, 1.0 and 0.5 of the 96h LC50 of both substances. It was a flow device which was closed only for measurement for one hour. Aldrin (1.5 LC50) causes a continuous reduction of respiration until death. The same effect occurred with Clarias batrachus for 1.5 LC50 of the tenside, whereas with Cirrhina mrigala death was caused by a pronounced increase of respiration. In all other cases, after a phase of sensitization for 4-8 h respiration increased considerably to more than 300% of the control, which was followed after 12-24 h by acclimatization to normal respiration values. (Author's abstract)
W85-06269

NITROGEN, PHOSPHORUS AND PRIMARY PRODUCTION IN THE POMERANIAN BAY,
Akademia Rolnicza w Szczecinie (Poland). Inst. of Fisheries, Oceanography and Protection of the Sea.
For primary bibliographic entry see Field 2L.
W85-06270

ACUTE TOXICITY OF PHENOL, PENTACHLOROPHENOL AND SODIUM PENTACHLOROPHENATE TO A FRESHWATER OSTRACOD CYPRIS SUBGLOBOSA (SOWERBY),
Udaipur Univ. (India). Dept. of Limnology and Fisheries.
P. S. Rao, V. S. Durve, B. S. Khangarot, and S. S. Shekhawat.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 4, p 457-465, 1983. 1 Fig, 4 Tab, 32, Ref.

Descriptors: *Toxicity, *Phenol, *Pentachlorophenol, *Sodium pentachlorophenate, *Ostracods, Phenols, Biocides, Chlorinated phenols.

The toxicity of phenol, pentachlorophenol and Na-pentachlorophenate to Cypris subglobosa was determined in a batch experiment for 96 h. The 96 h LC50 of the three substances were 71.8, 6.56 and 4.41 mg/l, respectively. In the range of 6-95 h the mean survival time shows a negative regression to the toxicant concentration, which, however, is not significant statistically for Na-pentachlorophenate. In agreement with this, the LC50 for 12, 24, 48, 72 and 96 h of exposure shows a significant decrease. Due to the comparatively high 96 h LC50 for pentachlorophenol and Na-pentachlorophenate for C. subglobosa in comparison with fish, the species is little suited to the toxicological investigation of wastewater. (Author's abstract)
W85-06271

TOXICITY AND TRACE ANALYSIS OF TENSIDES IN WATER (ZUR TOXIZITAT UND SPURENANALYSE VON TENSIDEN IN WASSER),
Akademie der Wissenschaften der DDR, Leipzig. Forschungsstelle fuer Chemische Toxikologie.
For primary bibliographic entry see Field 5A.
W85-06272

OXYGEN BUDGET OF THE WATERS OF THE FELDBERGER LAKEPLAIN BASED ON SUMMER DEPTH PROFILES FOR 1924 AND 1962, PART 3: SCHARTEISEN, WASCH-SEE, DOLGENER SEE (ZUM SAUERSTOFFHAUSHALT DER GEWASSER DER FELDBERGER SEENPLATTE AN HAND AUSGEWAHLTER SOMMERLICHER TIEFENPROFILE SEIT 1924 UND 1962, TEIL 3: SCHARTEISEN, WASCH-SEE, DOLGENER SEE),
W. M. Richter.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 5, p 539-558, 1983. 10 Fig, 4 Tab, 41 Ref.

Descriptors: *Depth profile, *Oxygen budget, *Scharteisen, *Wasch-See, *Dolgener See, Transparency, Water temperature, Hydrogen sulfide, Eutrophication, Dissolved oxygen, Water quality, Drinking water, Fisheries.

This paper presents the depth profiles for 1951-1980 for the Scharteisen, and in later years for the Wasche lake and the Dolgen lake for the oxygen regime, showing oxygen concentration, transparency, water temperature and the upper limit of the occurrence of hydrogen sulfide. The profiles demonstrate that eutrophication has occurred for the Scharteisen and is the present state of the three lakes. The general situation of the drainage areas and the causes of changes of the water quality as well as possible measures and aims of sanitation measures are discussed. Also the most important data are given on the hydrography of these waters related to their utilization for drinking water and by fisheries. (Author's abstract)
W85-06274

OCCURRENCE OF DDT AND POLYCHLORINATED BIPHENYLS (PCB) IN FISH FROM LAKES IN SCHWERIN COUNTY (ZUM VORKOMMEN VON DDT UND POLYCHLORIERTEN BIPHENYLEN (PBC) IN FISCHEN AUS SEEN DES BEZIRKES SCHWERIN),
Bezirks-Hygieneinspektion und -Inst., Schwerin (German D.R.).
J. Stechert, and A. Jantz.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 5, p 559-567, 1983. 4 Fig, 29 Ref.

Descriptors: *DDT, *Polychlorinated biphenyls, *Fish, *Schwerin, *Germany (Democratic Republic), Water pollution effects, Eels, Trout, Aquaculture, Bioaccumulation.

Investigations were made of 212 fish samples of eight fish species from 29 lakes in Schwerin county (German Democratic Republic). Determinations were made gas-chromatographically after chemical derivatization. In lakes with a low anthropogenic load the following concentrations were found: 0.05 mg/kg DDT, 0.03 mg/kg PCB. In lakes with higher pollution, the concentrations were 0.21 mg/kg DDT and 0.42 mg/kg PCB. The limit of tolerance for foodstuffs was never exceeded and predatory fish did not show higher concentrations than non-predacious fish. For ten eels, however, the mean contents were 1.6 mg/kg DDT and 0.36 mg/kg PCB. The total content of DDT in all fishes was composed as follows: 70-75% p,p'-DDE, 15-20% p,p'-DDD and 5-10% p,p'-DDT. Trout from an intensive-breeding plant contained 0.16 mg/kg DDT and 0.04 mg/kg PCB from the contaminated feed. By means of a change-over to different feed the contents were reduced to 0.03 mg/kg DDT and 0.04 mg/kg PCB. (Author's abstract)
W85-06275

STABILITY OF THE STATIONARY STATE OF A EUTROPHIC WATER POOL,
Bulgarian Academy of Sciences, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika.
I. K. Sivriev.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 5, p 603-606, 1983. 4 Ref.

Descriptors: *Eutrophication, *Stability analysis, *Ponds, Dissolved oxygen, Water temperature, Water pollution effects, Model studies, Stationary process.

Over the course of time a given pool eutrophies and the total quantity of substance in the pool increases, due to the increased pollution of the environment. Since this is a slow process, for any fairly short period of time the state of the pool can be considered as stationary with respect to the total quantity and distribution of substances in it. A simple analytical model of the conditions at which the stationary state of a pool is disturbed is used to study the stability of the stationary state on the eutrophic pond. The scheme of circulation of the substances in a eutrophic water pool along the cycle minerals-photosynthesizing biomass-organic substrate is given. The requirement that the average time value of the oxygen concentration in the pool is greater than the saturation oxygen concentration at the existing temperature and presssure is a necessary condition for disturbance of the stability of the stationary state. (Baker-IVI)
W85-06277

IN SITU NITROGEN ENRICHMENT EXPERIMENTS IN TWO IDAHO (U.S.A.) STREAMS,
Idaho State Univ., Pocatello. Dept. of Biology.
C. Y. Manuel-Faler, G. W. Minshall, R. W. Dunn, and D. A. Bruns.
Environmental Monitoring and Assessment, Vol. 4, No. 1, p 67-79, March, 1984. 2 Fig, 3 Tab, 38 Ref.

Descriptors: *Nitrogen, *Nutrients, *Streams, *Algae, *Idaho, *Deep Creek, *Big Wood River, Chlorophyll a, Algal growth, Periphyton, Biomass, Species composition, Water pollution effects.

A series of in situ experimental nutrient additions was conducted in two Idaho streams: Deep Creek, a desert stream located in Southeastern Idaho, and Big Wood River, situated in a mountainous region of Central Idaho. In both streams, a homogeneous reach was partitioned into almost identical channels. This allowed one to vary nutrient levels and measure algal response in experiments uncomplicated by differences in other factors. Ammonium nitrate was added to the treatment channels in Deep Creek. After nine days, Cladophora glomerata still predominated in both the control and treatment channels and algal biomass was not statistically different between the two. In the Big Wood River experiment significant differences in chlorophyll a concentrations were not detected among three treatments of differing nitrogen enrichment and the control for both natural and artificial substrates. Also chlorophyll a levels were not correlated with nitrogen concentrations, and the composition of algal communities remained similar among all treatments. It is concluded that macronutrient enrichment of streams does not necessarily result in an increase in algal density or a change in algal community structure so long as other factors, which may limit the use of nutrients by algae, remain unaltered. The results suggest that light, current velocity, and macroinvertebrate grazing may account for the failure of the periphyton to respond to in situ additions of nitrogen (and phosphorus) in the study streams. (Author's abstract)
W85-06284

HIGH PCB RESIDUES IN BIRDS FROM THE SHEBOYGAN RIVER, WISCONSIN,
Patuxent Wildlife Research Center, Laurel, MD.
G. H. Heinz, D. M. Swineford, and D. E. Katsma.
Environmental Monitoring and Assessment, Vol. 4, No. 2, p 155-161, June, 1984. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Polychlorinated biphenyls, *Birds, *Sheboygan River, *Wisconsin, Water pollution effects, Foods.

Organochlorine residues were measured in the carcasses and, in some cases, brains and stomach contents of four species of birds collected along the Sheboygan River, Wisconsin during the years 1976 to 1980. Polychlorinated biphenyls (PCBs) were high in all samples and were the contaminants of greatest concern. Carcass residues ranged from 23 to 218 ppm PCBs on a wet weight basis; these are levels associated with reproductive impairment in laboratory studies with some birds. Food items in the stomachs of collected birds contained from 12 to 58 ppm PCBs, indicating a heavy contamination of food sources. The brain of one bird contained 220 ppm PCBs, a level that is not in the lethal range but is very high. Birds feeding in the contaminated portions of the Sheboygan River may have been harmed by high PCB levels. (Author's abstract)
W85-06288

CHANGES IN WATER QUALITY IN FINNISH LAKES 1965-1982,
R. Laaksonen, and V. Malin.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 52-58, 1984. 10 Fig, 4 Tab, 3 Ref.

Descriptors: *Water quality, *Lakes, *Finland, Linear regression analysis, Electrical conductivity, Nutrients, Sulfur, Chloride, Cluster analysis, Water pollution.

Linear regression analysis was used to uncover possible trends in water quality at a network of observations (160) at deep places in lakes in Finland. Observations were made in March 1965-1982 at 4 depth levels in the water column. The parameters included were oxygen, conductivity, alkalinity, pH, color, total sulfur, chloride, iron, organic carbon, total nitrogen and total phosphorus. The trends uncovered in water quality in the period 1965-82 have grown clearly in number and statistical significance since the investigation of the period 1965-77. According to the records for 1970-82, the increase has come to a stop. The parameter that has changed the most is still electrolytic conductivity, which accounts for 34% of the total trends. It is followed by chloride, alkalinity and sulfur. Of the trends evident in 1965-82, 73% indicate a deterioration in water quality; the corresponding proportion for 1970-82 is 65%. Half of this slowing down of the deterioration is due to electrolytic conductivity. Cluster analysis has also been employed to examine the changes in water quality at the middle depth in the water column in the periods 1965-70 and 1977-82. The dominant feature appears to be a decrease in the group of stations in a natural condition. Evidence of change was found especially in shifts in the distribution of the values for electrolytic conductivity and total nitrogen. (Moore-IVI)
W85-06295

CHANGES IN IONIC DISTRIBUTIONS IN FINNISH LAKE WATER DURING THE PERIOD 1968-1983,
R. Laaksonen, and V. Malin.
Vesientutkimuslaitoksen Julkaisuja, Vol. 57, p 59-60, 1984. 1 Tab. 1 Ref.

Descriptors: *Finland, *Lakes, *Acid rain, Water pollution effects, Sulfates, Nitrates, Water quality, Chemical composition, Calcium, Magnesium, Sodium, Potassium, Carbonates, Chlorides, Electrical conductivity.

Considerable changes were noted during the period 1968-1983 in the ionic distributions in Finnish lake water. These changes are thought to be related to acid rain effects. Specific measurements were made of the concentrations of calcium, magnesium, sodium, potassium, hydrocarbonate, sulfate, and chloride. Data from 104 deepwater stations was used for the investigation. The concentrations of cations was 4.0% greater than that of anions during the period 1968-1970. By 1981-1983 this discrepancy had increased to 11.5%. The concentration of cations increased between the two observation periods by 9.5%, while that of anions increased only by 2.1%. The mean electrical conductivity of the water at the stations increased during the same period by 11.3%. The change was similar whether the waters were known to be polluted or were relatively undisturbed. (Baker-IVI)
W85-06296

EFFECTS OF SILTATION ON EMBRYONIC MORTALITY OF TROUT,
Case Western Reserve Univ., Cleveland, OH. Dept. of Biology.
J. Koonce, and M. Teraguhi.
Available from the National Technical Information Service, Sprinfield, VA 22161 as PB85 157642/AS, Price codes: A05 in paper copy, A01 in microfiche. Ohio State University, Columbus, Water Resources Center, Project Completion Report No. 544, July 1980. 28 p, 3 Fig, 11 Tab, Project No. OWRT B-071-OHIO (1), Contract/Grant No. 14-34-0001-7178.

Descriptors: *Silt load, Water pollution effects, Silts, Fish reproduction, Stream fisheries, Stream pollution.

The hypothesis that siltation in streams eliminates the natural reproduction of trout by increasing mortality during embryonic development was tested. Several environmental factors (temperature, dissolved oxygen and flow rates) are known to affect embryonic development. These factors all change with siltation in streams, but the interaction of these factors with silt needed more definition. If the extent of which silt alone affects embryo mortality could be determined, procedures could be developed to improve trout reproduction in silted streams. This project attempted to define the critical period of susceptibility of trout embryos to siltation. The findings were that the effects of siltation on embryonic development are indirect. Silt alone does not increase embryonic mortality but it apparently alters the physical characteristics of the gravel substrate and affects the flow rates through the gravel and the dissolved oxygen concentrations within the gravel. Further, it may restrict embryonic emergence.
W85-06311

EFFECT OF ASH FALLOUT ON WATER QUALITY IN WESTERN MONTANA,
Montana Univ., Missoula. Dept. of Chemistry.
R. E. Juday, and E. J. Keller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157824/AS, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, March, 1984. 147 p, 2 Fig, 46 Tab, 106 Ref, 5 Append, Project No. OWRT C-10095-V (1), Contract/Grant No. 14-34-0001-1469.

Descriptors: Mt. St. Helens, *Washington, Ash fallout, Water quality changes, Algal productivity, Clearwater lakes, Extractable nutrients, *Volcanoes, Trophic states, Sedimentation.

Subsequent to the eruption of Mount St. Helens in 1980, a water quality study was conducted on lakes

and streams of the Clearwater drainage of Western Montana and several oligotrophic high mountain lakes in Idaho. Field studies indicated that the fallout, although containing appreciable amounts of water soluble nutrients, had virtually no effect on productivity of oligotrophic lakes. Appreciable increases in algal productivity were noted in the mesotrophic study lakes in 1980, although they were no larger than might be expected from climatological changes or from local logging activity. Laboratory studies showed that, imitating natural conditions, appreciable amounts of nutrients could be extracted from the ash, and that the extracts increased algal productivity in incubated lake samples.
W85-06325

1,2-DICHLOROPROPANE (1,2-D)–1,3-DICHOLOROPROPENE (1,3-D),
California State Water Resources Control Board, Sacramento.
D. B. Cohan, D. Gilmore, C. Fisher, and G. W. Bowes.
Special Projects Report No. 83-8sp, August 1983, 86 p, 20 Fig, 25 Tab, 142 Ref, 10 Append.

Descriptors: *Soil-water-plant relationships, *Fumigants, *Pesticides, *Agricultural chemicals, *Soil organic matter, *Repellants, *Carcinogens, Pesticide toxicity, Nematodes, Soil contamination, Dichloropropane, Dichloropropene, 1,2-D, 1,3-D.

The investigation of 1,2-dicholoropropane (1,2-D) and 1,3-dichoropropene (1,3-D) was prompted by a concern about the long-term use of these soil fumigants because of their chemical similarity to DBCP and possible persistence in soil of 1,2-D. In addition, there has been a recent dramatic increase in their reported use in California from 4 million pounds in 1977 to over 16 million pounds in 1981, and there is a suspected potential mutagenicity and carcinogenicity. Initial surveys discovered 1,2-D in California ground water in an increasing number of shallow and deep wells in eight counties from Kern County in the south to Del Norte County in the north. None of the sites sampled contained detectable concentrations of 1,3-D. Most of the 1,2-D findings appeared to be related to agricultural use of nematicides rather than from industrial discharge. Repeated exposure to 1,2-D causes liver and kidney damage in experimental animals, yet 1,2-D is much less effective than 1,3-D as a soil nematicide and therefore is not essential. To prevent further contamination of ground water by 1,2-D in California, it is recommended that EPA and registrants of products containing 1,2-D take immediate action to reduce the 1,2-D content to the lowest practical level (i.e., less than 2%), and that permits should not be issued by county agricultural commissioners for restricted materials having unacceptably high levels of 1,2-D. (Hawkins-Omniplan)
W85-06332

CALIFORNIA STATE MUSSEL WATCH, 1981-1983, BIENNIAL REPORT,
California State Water Resources Control Board, Sacramento, CA. Div. of Surveillance and Monitoring.
J. M. Ladd, S. P. Hayes, M. Martin, M. D. Stephenson, and S. L. Coale.
Water Quality Monitoring Report No. 83-6TS, January 1984. 78 p, 31 Fig, 5 Tab, 24 Ref, 10 Append.

Descriptors: *Mussels, *Baseline studies, *Pesticide toxicity, Water pollution sources, *Water pollution effects, *Mollusks, *Mytilus, On-site data collections, Trace metals, Estuarine environment, Bays, Wastewater pollution, Humboldt Bay, Alamitos Bay, San Francisco Bay, Redwood Creek, Moss Landing, California, Los Angeles, Long Beach, DDT, Toxaphene, Endosulfan, Pentachlorophenol, PCB, Chlorinated hydrocarbons.

Toxic pollutant levels in mussels from coastal, bay and estuarine areas were monitored during 1981-1983 as part of an ongoing Mussel Watch Program. Samples were analyzed for about 55 synthetic organic compounds, primarily chlorinated pesticides and PCBs. Also studied were about ten trace metals. Collections were made at more than 150 stations, and there were site-specific surveys at five locations. Silver concentrations in mussels were found over a wide range of about 50,000 fold. In addition, there appears to be a good relationship between silver concentration in mussels and the proximity of mussels to municipal wastewater discharges. Baseline monitoring in bay and estuarine areas indicated that shellfish in Alamitos Bay should continue to be monitored due to the elevated lead and chlorinated pesticide levels found there. The detection of a wood preservative, pentachlorophenol, in mussels from Humboldt Bay warrants further study. The Redwood Creek area of South San Francisco Bay no longer appears to be the site of a significant silver input; however, there was evidence of a significant input (1981-82) with its abatement unexplained. The Moss Landing drainage area yielded mussels, fish and water with relatively high levels of a wide variety of pesticides, particularly toxaphene, endosulfan, and DDT. Los Angeles/Long Beach Harbor should continue to be monitored to determine if clean-up and abatement actions result in reduced levels of DDT and metabolites in the harbor. (Hawkins-Omniplan)
W85-06333

RELATIVE EFFECTS OF CHLORINE AND AMMONIA FROM WASTEWATER TREATMENT FACILITIES ON STREAM BIOTA,
Southern Illinois Univ. at Carbondale.
R. C. Heilinger, W. M. Lewis, M. H. Paller, J. H. Waddell, and L. J. Wawronowicz.
Illinois Department of Energy and Natural Resources Document No. 83/24, September 1983, 109 p and 220 p, 14 Fig, 25 Tab, 31 Ref, 12 Append (in separate volume).

Descriptors: *Fish populations, *Chemical treatment, *Stream degradation, *Fish toxins, *Streams, *Stream pollution, *Secondary wastewater treatment, Chlorination, Wastewater treatment, Sludge, Ammonia, Wastewater facilities.

Three Champaign-Urbana area sewage receiving streams were monitored with regard to on biological, chemical and physical variables from 1979 to 1983. During a period when the streams received chlorinated secondary effluent, the fish community in Copper Slough was extremely poor quantitatively and qualitatively; but within seven days after the cessation of chlorination, the fish community recovered to levels characteristic of ambient areas above the outfall. The Kaskaskia Ditch fish community responded similarly to the cessation of chlorination. Recovery occurred in these streams despite ammonia-nitrogen concentrations typical of good quality secondary sewage effluent. However, the fish community in Saline Branch did not recover immediately after the cessation of chlorination, in part because this coincided with a worsening of other effluent quality parameters due to operational problems caused by plant renovation. As a result, very high ammonia levels, very low oxygen levels and the deposition of sludge materials were observed. The elimination of residual chlorine from good quality secondary sewage effluents will result in restoration of fish communities in average Illinois streams receiving such effluents. The reduction of ammonia concentrations from typical secondary treatment levels to extremely low levels by tertiary treatment will not necessarily effect obvious improvements. (Hawkins-Omniplan)
W85-06342

EVALUATION OF WASTES FROM THE EAST ST. LOUIS WATER TREATMENT PLANT AND THEIR IMPACT ON THE MISSISSIPPI RIVER,
Illinois State Water Survey Div., Champaign.
S. Lin, R. L. Evans, D. Schnepper, and T. Hill.
ISWS Circular 160, 1984. 62 p. 16 Fig, 20 Tab, 24 Ref, 3 Append.

Descriptors: *Waste disposal, *Solid waste disposal, *Waste identification, *Wastewater disposal, *Wastewater treatment, *Clarification, *Clarified wastewater, River bed, Navigable rivers, River mechanics, Benthic fauna, Iron, Aluminum, Wastewater Facilities, East St. Louis, Illinois.

The disposal of wastes has been troublesome and costly for the water industry. For nearly two decades a number of alternative methods, including lagooning, mechanical or gravity thickening, and pipeline transport have been practiced. Unfortunately, little information on the impact of wastes from water treatment plant discharges on receiving streams is available. The quantity and characteristics of wastes generated by the East St. Louis, Illinois, water treatment plant, which is a large plant employing the clarification process were studied. The major chemical constituents of the solid wastes are iron and aluminum. Except during 7-day 10-year low-flow conditions, increases in suspended solids in the Mississippi River during occurrences of maximum waste discharges will not be perceptible. The influence of the waste is detectable in the bottom sediments of the river by increases in iron, aluminum, moisture, and organic content, and by changes in particle size distribution. However, that influence is limited to an impacted area about 100 feet offshore and within 4,000 feet downstream of the waste outfalls. The types of changes in the composition of the sediments are not a mark of environmental degradation. This conclusion is strengthened by observations of benthic macroinvertebrates in the area. There was no significant difference in the nearshore stations upstream or downstream of the waste outfalls in terms of macroinvertebrates. (Hawkins-Omniplan)
W85-06343

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, APPENDIX--RARITAN RIVER BASIN,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-C: 1.B, June 1983. 94 p, 1 Tab, 50 Fig.

Descriptors: *Rivers, *Watersheds, On-site data collections, *Water pollution sources, Dissolved oxygen, Anaerobic conditions, Groundwater basins, Large watersheds, Drainage area, On-site test data, Coliforms, *New Jersey, *Raritan River basin, Water quality.

The Raritan River's five watersheds are surveyed in terms of water quality, problem assessment, and goal assessments and recommendations. The North Branch of the Raritan is primarily in a wooded and rural area, where septic systems are employed in most areas. Water quality varied from good to marginal in localized areas, and there have been periodic problems with dissolved oxygen and nutrient levels. Current municipal treatment plants need to be upgraded. At the South Branch, where the watershed is also primarily rural, high levels of trihalomethanes were found at two locations. Point source controls are needed at several locations. The Millstone River basin has several population centers with generally good water quality in its upstream segment which declined to marginal conditions downstream. Fecal coliform concentrations increased downstream and were periodically above 200 MPN/100 ml in two locations. Biological data suggest the presence of a stressed community. Some dredging and agricultural best management practices need to be implemented. At the Lawrence Brook and South River watersheds, the terrain is varied as is the water quality. There were fluctuations in pH values at various sites, and 36 percent of the fecal coliform data for Lawrence Brook exceeded 200 MPN/100 ml. The Lower Raritan River Basin is primarily urban/suburban, where water quality was moderate to poor due to frequently excessive levels of BOD5, total ammonia and un-ionized ammonia and dissolved solds. PCB Arochlor 1254 was recorded in virtually all tissue samples. (Hawkins-Omniplan)
W85-06352

SULPHURIC ACID AND OLEUM, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W85-06355

SULPHUR, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W85-06356

BENZENE, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W85-06357

ROCKY MOUNTAIN ACIDIFICATION STUDY,
Colorado State Univ., Fort Collins. Natural Resources Ecology Lab.
J. H. Gibson, J. N. Galloway, C. Schofield, W. McFee, and R. Johnson.
Available from Supt. of Documents, GPO, Washington, D.C. 20402. Report FWS/OBS-80/40.17; Air Pollution and Acid Rain Report No. 17, October 1983. 137 p, 32 Fig, 24 Tab, 109 Ref, 4 Append.

Descriptors: *Watersheds, *Deposition, *Acidification, *Sensitivity analysis, *Fish populations, *Geology, Nitrate, Sulfate, Acidity, Fisheries, Granite, Schist, Gneiss, Water chemistry, Rocky Mountains, *Acid rain, Colorado, Wyoming.

This report presents information gathered to: 1) determine the sensitivity of watersheds characteristic of the Rocky Mountain Region and the relationship of watershed sensitivity to geology and soils, 2) evaluate the extent of current acidification and the potential for increasing acidification with increasing deposition of nitrate and sulfate, 3) evaluate the results of the above in terms of impacts on fish populations, 4) develop recommendations for assessment of future trends in both changing water chemistry and impacts on fish populations. Areas were selected for study which had minimal human impact and for which the maximum amount of data on soils, geology and water chemistry already existed. The Rocky Mountain National Park and Yellowstone National Park areas selected exemplified two different geologic types. The geology of these areas is representative of a large portion of that in the total Rocky Mountain region. In addition, data on precipitation chemistry were available from the National Atmospheric Deposition Program monitoring studies in the two parks. Tha analysis of sensitive aquatic systems have been extra-polated to the Central Rocky Mountain Region (CRMR) by delineating areas underlain by granite biotite gneiss and schist and similar gneisses and schists. Areas underlain by these formations are classified as sensitive (alkalinity < 200 micro eq/l), lakes and streams located at higher elevations (> 3300 m) can be classified as very sensitive (alkalinity < 100 micro eq/l). Areas underlain by tertiary intrusive rocks were classified as nonsensitve (alkalinity > 200 micro eg/l). The CRMR receives precipitation that is somewhat acidic (average annual pH approximately equal to 5.0, NADP 1982). With respect to fish populations, this acidification is not chronic enough to impact on area fisheries.
W85-06359

LOWER CUCKELS BROOK WATER BODY SURVEY AND USE ATTAINABILITY ANALYSIS,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
J. T. Reading, and W. P. Minervini.
Revised April, 1983. 20 p. 4 Tab, 7 Ref, 1 Append.

Descriptors: *Water analysis, *Chemical wastes, *Industrial wastes, *On-site data collections, *On-site tests, *Streams, *Wastewater pollution, *Aquatic environment, Wastewater disposal, Sewage disposal, Effluent streams, Sludge, Effluent.

This study illustrates the application of use attainability analysis to Cuckels Brook, a small stream segment in heavy industrial surroundings in New Jersey that receives large volumes of wastewater. A water body survey was comprised of water chemistry sampling at five stream stations and of sampling of effluent from the American Cyanamid plant. This data was supplemented for the use attainability analysis by existing effluent self-monitoring chemistry and bioassay data, effluent compliance monitoring data, and stream data from surveys and studies. The Cyanamid discharge contained 0.8 mg/l TRC. Concentrations at two stations were 0.3 mg/l TRC, 100 times the state criterion. Concentrations of instream filterable residue levels were 1,100 mg/l, more than three times the state criterion. Three species of fish, collected with a quarter-inch seine and a dip net, were found: the banded killifish, the creek chub and th blacknose dace. At Lower Cuckels Brook, visual observation and chemical data suggest that virtually no aquatic life exists there, including algae. Numerous organic chemicals were found in effluents, but their concentrations were generally at low levels, under 10 mg/l. If discharges were removed from Lower Cuckels Brook and piped to the Raritan River, wastewater sludge deposits on the bottom would need to be removed to permit limited aquatic life and recreational uses, since this segment is on private land. (Hawkins-Omniplan)
W85-06361

IMPACT OF SEWAGE BYPASS ON NEWARK BAY,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
S.-F. Hsueh, and T.-R. Jeng.
April 1982. 22 p. 6 Tab, 4 Fig, 7 Refs.

Descriptors: *Estuarine environment, *Sewer districts, *Wastewater disposal, *Jurisdiction, *Bays, *Wastewater treatment, *Wastewater discharge, Wastewater, Sewage bacteria, Biochemical oxygen demand, Dissolved oxygen, Treated water, Estuaries.

Severe stress on the dissolved oxygen concentrations in Newark Bay and the adjacent areas of the tributaries was placed when construction and upgrading of sewerage facilities was delayed for three months. The magnitude of the impact, based on two sets of water quality data, was that the bypass discharge of approximately 270 mgd of sewage from the Passaic Valley Sewerage Commission (PVSC) facility violated the DO standard for Newark Bay, and that the water quality was in a severely degraded and anaerobic condition during the summer of 1980. During the high tide period, the impact on the Passaic and Hackensack Rivers was detected (Higher T0C and lower D0) at stations S-1 and S-2. Relatively high DO was detected at station S-8. As this station was located at the mouth of Newark Bay, the impact due to the incoming tide through the Kill Van Kull River was considered the major reason. Under the low tide period, stations in the Passaic and Hackensack Rivers were not affected by the bypass discharge. All other stations in the complex are considered to be in an anaerobic condition due to the extremely low DO levels. The physical characteristics and dynamic behavior of the estuarine system must be established in order to provide a sound basis for further analysis. The longitudinal distribution of chlorides was used to estimate dispersion coefficients for different segments. One year after cessation of the bypass discharge, a follow-up monitoring program was conducted by the PVSC using two more sampling stations. The entire system had already recovered from the damage. (Hawkins-Omniplan)
W85-06362

STUDIES OF TOXIC EFFECTS OF HG(II) ON PISTIA STRATIOTES,
Visva-Bharati Univ., Santiniketan (India). Dept. of Chemistry.
A. K. De, A. K. Sen, D. P. Modak, and S. Jana.
Water, Air and Soil Pollution, Vol. 24, No. 4, p 351-360, April, 1985. 5 Tab, 28 Ref.

Descriptors: *Mercury, *Toxicity, *Absorption, *Pistia, *Aquatic plants, Chlorophyll, Protein, Phytotoxicity, Water pollution effects, Industrial wastes.

The uptake of Hg(II) and toxicity effect of the metal on some biochemical parameters in Pistia stratiotes were studied. At 20 ppm, Hg(II) promotes senescence of Pistia plants by general inhibition of the biosynthesis of cellular metabolites, impairing the degradation of the biochemical constituents and also interfering with the nucleic acid biosynthesis and protein synthesizing machinery in the plant. At concentrations below 20 ppm of Hg(II), the metabolic activities of the plant are least affected, probably because there is a route by which the metal ion may be accumulated in the vacuolar system of the plant. Maximum removal (about 90%) of Hg(II) by plants was recorded below 20 ppm within 24 hr. (Baker-IVI)
W85-06372

MICROBIAL TRANSFORMATION OF ALKYLPYRIDINES IN GROUNDWATER,
Battelle Pacific Northwest Labs., Richland, WA.
J. E. Rogers, R. G. Riley, S. W. Li, M. L. O'Malley, and B. L. Thomas.
Water, Air, and Soil Pollution, Vol. 24, No. 4, p 443-454, April, 1985. 1 Fig, 4 Tab, 18 Ref. DOE contract AC06-76RLO 1830.

Descriptors: *Microbial degradation, *Groundwater pollution, *Alkylpyridines, Aerobic degradation, Anaerobic degradation, Degradation, Bacteria, Water pollution effects, Water quality control.

The microbiological degradation of a mixture of alkylpyridines in groundwater maintained under aerobic and anaerobic conditions was examined. For 5 years, sampling wells located within a drainage adjacent to the Anvil Points oil shale facility near Rifle, Colorado, were monitored for the presence of nitrate, ammonium ion, DOC, DO and alkylpyridines. The persistence of the mixture of alkylpyridines present in alluvial groundwaters obtained from well AV3 was investigated. In the presence of soil inoculum and under aerobic conditions, the residual alkylpyridine concentrations generally approached zero concentration within 10 to 31 days of incubation. The observed range of biotransformation rates was dependent on molecular weight with the lighter alkylpyridines generally being transformed at a faster rate than the heavier analoga. A marked effect on the biotransformation rate was also noted with respect to the specific ring substitution of structural isomers within a given weight class. The concentration of two of the 5-carbon substituted alkylpyridines were reduced by microbial activity to less than detectable values within 10 days of incubation, whereas the concentration of a third was reduced to less than detectable concentration within 24 days and a significant level of the fourth remained over the duration of the study. Microbiological transformation of alkypyridines was also noted under anaerobic conditions. The biotransformation rates and the effects of molecular weight and the specific ring substitution of stuctural isomers were not as pronounced when compared with degradation rates observed under aerobic conditions. A 12- to 18-fold reduction in the concentration of all alkylpyridines, C3 and greater, was noted in anaerobic experiments following the purging of water samples with argon to remove oxygen. Microbial population increased during the incubation period for aerobic and anaerobic experiments. (Baker-IVI)
W85-06374

PHYTOPLANKTON OF THE LOWER DNIEPER (FITOPLANKTON NIZHNEGO DNEPRA),
V. S. Polishchuk, and V. A. Tomnitsky.
Gidrobiologicheskі Zhurnal, Vol. 21, No. 1, p 8-11, 1985. 2 Fig, 10 Ref.

Descriptors: *Phytoplankton, *Water pollution effects, *Dnieper, *USSR, Primary productivity, Organic matter, Photosynthesis, Hydrological properties.

The paper presents data concerning the qualitative and quantitative phytoplankton development in different branches and the river-bed part of the lower Dnieper (USSR). Hydrological conditions and waste waters are analyzed for their effect on phytoplankton development as well as on the pri-

mary production and destruction. Organic substances formed by phytoplankton in the mouth under photosynthesis are qualitatively estimated for their flow into the Dnieper-Bug leman. (Author's abstract)
W85-06375

DYNAMICS OF ZOOPLANKTON IN THE CHERNOBYL ATOMIC POWER PLANT WATER COOLING (SEZONNAYA DINAMIKA ZOOPLANKTONA VODOEMA-OKHLADITELYA CHERNOBY'SKOI ATOMNOI ELEKTROSTANTSII),
O. A. Sergeeva.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 32-36, 1985. 3 Fig, 4 Tab, 4 Ref.

Descriptors: *Zooplankton, *Thermal pollution, *Nuclear powerplants, *Pripyat River, *USSR, Cooling water, Water pollution effects, Wastewater pollution, Species composition, Weather.

The paper presents data concerning the species composition and quantitative development of zooplankton, its distribution along the water area of the Chernobyl Atomic Power Plant (APP) water cooling (heat demand 7.5 t.cal/sq m/day) depending on a degree of artificial heating in different years in the season aspect. Long discharge of APP heated waters as well as of domestic sewage, and constant water pumping from the Pripyat River, USSR under different weather conditions result in changes in the structure of zooplanktonic community. (Author's abstract)
W85-06377

INFLUENCE OF CERTAIN TOXICANTS ON DAPHNIA MAGNA STRAUS SURVIVAL RATE IN THREE-FACTOR EXPERIMENT (VLIYANIE NEKOTORYKH TOKSIKANTOV NA VYZHIVAEMOCT' DAPHNIA MAGNA STRAUS V TREKHFAKTORNOM EKSPERIMENTE),
M. Preshing.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 72-75, 1985. 1 Tab, 12 Ref.

Descriptors: *Daphnia, *Toxicity, *Pesticides, 2,4-D, Atrazine, Copper, Herbicides, Diconirte, Actikone K, Synergism, Water pollution effects.

The combined effect of three pesticides on Daphnia magna survival rate is determined according to the CFE = 23 procedure under laboratory conditions at the temperature 20 C and 1-, 2-, 3-, 4- and 5-day exposure. The toxicant concentrations are as follows: 400 mg/l for 2,4-D, 10 mg/l for atrazine and 0.04 mg/l for copper. The combined effect of herbicides on Daphnia survival rate is synergism, that of diconirte and copper is antagonism and that of actikone K and copper is an additive effect. (Author's abstract)
W85-06379

DISTRIBUTION AND ELIMINATION OF HEXACHLOROBENZENE, OCTACHLOROSTYRENE AND DECACHLOROBIPHENYL IN RAINBOW TROUT, SALMO GAIRDNERI,
National Veterinary Inst., Oslo (Norway).
G. Norheim, and S. O. Roald.
Aquatic Toxicology, Vol. 6, No. 1, p 13-24, February, 1985. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Trout, *Organochlorine compounds, *Water pollution effects, Path of pollutants, Hexachlorobenzene, Octachlorostyrene, Decachlorobiphenyl, Hydrocarbons.

In two experiments rainbow trout, Salmo gairdneri, were injected intraperitoneally with an oil solution containing hexachlorobenzene (HCB) and octachlorostyrene (OCS), or a mixture of hydrocarbons extracted from fish in a contaminated area. HCB and OCS were determined by gas chromatography in fat, liver, and muscle, and decachlorobiphenyl (DCB) was determined in fat. The water temperature was 7 C and both experiments lasted 37 weeks. The distribution of HCB, OCS and DCB in liver, fat, and muscle tissue, after ip injection did not seem to reach a steady state during this study period. When comparing concentrations in different tissues, larger variations were seen for OCS than for HCB. The ratio for HCB between liver and fat in experiment 1 decreased with a factor of about two from week 1 to week 37. The corresponding figure for OCS was almost 7. The ratio between liver and muscle also decreased for both substances. The ratio between muscle and fat increased slightly with regards to HCB, while it reached a maximum at week 5 for OCS. Consequently the ratio between HCB and OCS decreased in all tissues analyzed, and in fat this ratio decreased by a factor of about 10 from week 1 to week 37 of the study. Changes in the ratios during experiment 2 showed in most cases the same trends. (Baker-IVI)
W85-06381

EFFECTS OF ACUTE EXPOSURE TO ACIDIFIED WATER ON THE BEHAVIORAL RESPONSE OF FATHEAD MINNOWS, PIMEPHALES PROMELAS, TO CHEMICAL FEEDING STIMULI,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
A. D. Lemly, and R. J. F. Smith.
Aquatic Toxicology, Vol. 6, No. 1, p 25-36, February, 1985. 1 Fig, 1 Tab, 27 Ref.

Descriptors: *Fish behavior, *Water pollution effects, *Acidity, *Fathead minnow, Acid rain, Behavior, Fish, Feeding.

Fathead minnows, exposed to acidified water (pH 6.0) for 72 hr, did not respond to a chemical stimulus that elicited a strong feeding response at higher pH levels. The lowest pH at which a statistically significant response occurred was 6.5. Visually oriented feeding still occurred. These results indicate that acidification significantly affects the ability of fathead minnows to detect and/or respond to a chemical feeding stimulus. The study also shows that the behavioral bioassay technique used in the experiments is suitable for detection and quantification of impaired chemoreception in fishes. Data suggest that feeding and hence growth, activity and reproduction could be seriously affected under natural conditions of acidification. Impairment of chemoreception, manifest in reduced ability to locate or select proper food, would be an important contribution factor to reduced fecundity and ultimate elimination of fathead minnows from acidified lakes. (Baker-IVI)
W85-06382

EXPOSURE OF TWO SPECIES OF DEPOSIT-FEEDING AMPHIPODS TO SEDIMENT-ASSOCIATED (3H)-BENZO(A)PYRENE: UPTAKE, METABOLISM AND COVALENT BINDING TO TISSUE MACROMOLECULES,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
W. L. Reichert, B.-T. Le Eberhart, and U. Varanasi.
Aquatic Toxicology, Vol. 6, No. 1, p 45-56, February, 1985. 2 Fig, 2 Tab, 34 Ref.

Descriptors: *Amphipods, *Macromolecules, *Water pollution effects, *Sediments, *Benzo(a)pyrene, Metabolism, Organic compounds, Marine environment.

Two species of deposit-feeding marine gammaridian amphipods, Rhepoxynius abronius and Eohaustorius washingtonianus, were exposed to sediment associated tritium-labeled benzo(a)pyrene (BaP) at 12 C. After 1 day of exposure both E. washingtonianus and R. abronius accumulated detectable levels of BaP-derived radioactivity. Concentrations of radioactivity in both species of amphipods increased significantly from 1 to 7 days. Total BaP-derived radioactivity was significantly higher in E. washingtonianus than in R. abronius after 1 day of exposure. At 3 and 7 days no significant differences were noted. Concentrations of unconverted BaP were significantly higher in E. washingtonianus than in R. abronius throughout the exposure. Reversed phase HPLC analyses of organic solvent-soluble metabolites after enzymatic treatment showed the presence of the following metabolites in both E. washingtonianus and R. abronius: 7,8-dihydroxy-7,8-dihydroBaP, 9,10-dihydroxy-9,10-dihydroBaP, 9-hydroxyBaP, 3-hydroxyBaP and PaP quinones. BaP metabolism was more extensive in R. abronius and higher levels of intermediates were covalently bound to macromolecules in R. abronius. Both E. washingtonianus and R. abronius biotransformed BaP to potentially carcinogenic and mutagenic metabolites. Analysis of the minor metabolites formed by the two amphipod species revealed the presence of the K-region metabolite, BaP-4,5-diol, in tissue extracts from E. washingtonianus but not in R. abronius. The findings demonstrate for the first time that covalent binding of BaP intermediates to tissue macromolecules occurred in both amphipod species. The higher levels of BaP intermediates in R. abronius may be due in part to the higher concentrations of metabolites in R. abronius as compared to E. washingtonianus. Other factors, such as protein turnover, may also affect the binding levels. The higher levels of covalent binding of PaB intermediates suggests a higher potential for disruption of cellular processes and subsequent impairment of the overall health of R. abronius in PAH-contaminated sediments. (Baker-IVI)
W85-06383

REDUCTION BY A SURFACTANT OF OLFACTORY MEDIATED ATTRACTION BETWEEN JUVENILES OF ARCTIC CHARR, SALVELINUS ALPINUS (L.),
Uppsala Univ. (Sweden). Inst. of Zoophysiology.
K. H. Olsen, and L. B. Hoglund.
Aquatic Toxicology, Vol. 6, No. 1, p 57-69, February, 1985. 4 Fig, 2 Tab, 27 Ref.

Descriptors: *Fish behavior, *Toxicity, *Water pollution effects, *Char, *Surfactants, Organic compounds, Salmonids, Olfactory behavior.

The effect of sublethal concentration of linear alkylbenzene sulfonate (LAS) on attraction to conspecific compounds was studied in juvenile Arctic charr, Salvelinus alpinus. Results indicated that LAS has an effect on odor perception in fish at concentrations as low as 0.02 ppm. The possibility of interaction between stimuli and surfactant by electrostatic and/or hydrophobic forces cannot be excluded. The conclusion reached in the present study is that sublethal concentrations of LAS disturb chemo-attraction in Arctic charr which indicates that the olfactory senses are affected. The disturbance is at least partly reversible. This does not reduce the ecological importance of the observations as even a short blockade of odor perception might be fatal if occurring at unsuitable occasions. Surfactants in low concentrations might make a home river less attractive to mature fish and affect their upstream movement. Morphological studies with the scanning electron microscope did not reveal any damage of the cell surface of the olfactory epithelium, including the receptor cells, after 4 days exposure to 2 ppm LAS. Locomotor activity in charr was not affected in this study. The fluviarium technique as performed here can be used for testing xenobiotic disturbance of fish behavior to predict effects of pollution. (Baker-IVI)
W85-06384

EFFECT OF AN AQUATIC HERBICIDE ON SEDIMENT NUTRIENT FLUX IN A FRESHWATER MARSH,
Manitoba Univ., Winnipeg. Dept. of Botany.
L. G. Goldsborough, and G. G. C. Robinson.
Hydrobiologia, Vol. 122, No. 2, p 121-128, March, 1985. 5 Fig, 1 Tab, 27 Ref.

Descriptors: *Marshes, *Water pollution effects, *Herbicides, *Sediments, *Nutrients, Organic compounds, Simazine, Dissolved oxygen.

Three concentrations of the herbicide simazine were added to in situ macrophyte-free enclosures with and without sediment contact. Changes in the concentrations of total ammonia, total reactive phosphorus, and silicon were monitored, and net sediment flux was calculated from the difference in nutrient concentration between bottomed (SB) and unbottomed (OB) enclosures. Two phases in the change in dissolved oxygen status of OB vs SB enclosures were identified. The first occurred soon

after enclosure placement and was characterized by lower oxygen concentrations in OB enclosures. This trend continued over the pretreatment period of 12 days suggesting that the decrease was a reflection of normal BOD and/or COD of marsh sediments. At the same time, lower oxygen levels appeared to be correlated with higher nutrient levels explaining the initial nutrient differences between the enclosures. The second change in dissolved oxygen levels of the enclosures occurred following herbicide treatment, specific levels being a function of herbicide concentration. This is indicative of a change in photosynthetic oxygen evolution and corresponding increases in BOD due to decay processes. Since macrophytes were not present in the enclosures, the observed deoxygenation may reflect inhibition of sediment epipelon, with some lesser influence upon planktonic and haptobenthic organisms. In light of the fact that simazine concentrations in OB enclosure decreased significantly over the experimental period, sediment adsorption of herbicide is probable, thereby increasing the phytotoxic concentration at the sediment/water interface. The change in oxygen concentration in relation to the herbicide level coincided with substantial changes in the concentrations of total ammonia, TRP, and silicon, pointing to a connection between inhibition of sediment biota and increase in nutrients. A major assumption of this work, is that the observed differences in nutrient levels between SB and OB enclosures following herbicide treatment reflects all and only sediment effects. Preliminary data indicate that the difference in algal colonization between SB and OB enclosures following herbicide treatment was greatest in control and 0.1 mg/l pairs, and decreased in relation to herbicide concentration at 1.0 and 5.0 mg/l simazine. (Baker-IVI)
W85-06386

EFFECT OF ACIDIFICATION IN ENCLOSURES ON THE BIOMASS AND POPULATION SIZE STRUCTURE OF BOSMINA LONGIROSTRIS,
West Virginia Univ., Morgantown. Dept. of Biology.
K. Havens, and J. DeCosta.
Hydrobiologia, Vol. 122, No 2, p 153-158, March, 1985. 5 Fig, 2 Tab, 12 Ref. NSF grant DEB-8211706.

Descriptors: *Acidity, *Water pollution effects, *Biomass, *Cladocera, Population dynamics, Zooplankton, Lakes, Acid rain, Lake O'Woods, West Virginia.

An in situ enclosure experiment was performed from June to September, 1982, in Lake O'Woods, West Virginia, pH 7.0, to examine the effects of acidification on the Bosmina longirostris population. Treatments were two control enclosures and two enclosures acidified from an initial pH of 7.2 to pH 4.2 over a 44 day period, using sulfuric acid. After day 44 chlorophyll a declined in the control but increased rapidly in the acid treatment so that by day 75 it was 8 times that in the control. An initial rapid increase in the abundance of B. longirostris in the acid treated water is noted. From day 16 onwards mean body length was consistently higher in the acid treatment. The difference was especially significant on day 30, coinciding with the maximal difference in abundance of the two populations. On days 16 and 20 the other dominant herbivores were significantly reduced in abundance in the acid treatment. Later in the experiment, the abundance of other herbivores increased in the acid treatment, and on day 58 was significantly higher than in the control. After day 16 carnivores declined rapidly in the acid treatment and were extinct by day 58. Acidification may have indirect secondary effects on lacustrine plankton populations. Altered competitive and predatory interactions may sometimes result in changes as dramatic as those caused by direct toxic effects of increased acidity. (Baker-IVI)
W85-06388

EXPERIMENTAL STUDIES ON THE EFFECT OF SODIUM CHLORIDE, DIMETHOATE AND BAYLUSCIDE ON THE GROWTH AND METABOLISM OF THE ALGA STAURASTRUM BOREALE W. WEST,
Institute of Oceanography and Fisheries, Cairo (Egypt).
E. A. Ibrahim.
Bulletin of the Zoological Society of Egypt, Vol. 33, p 87-97, 1983. 1 Fig, 1 Tab, 30 Ref.

Descriptors: *Water pollution effects, *Algal growth, *Salinity, *Dimethoate, *Bayluscide, Insecticides, Molluscicides, Organic compounds, Chlorophyll a, Pesticide residues.

The freshwater Lake Wadi el-Rayan is located in the lowest part of the Fayoum depression in Egypt. The organisms inhabiting Wadi E-Rayan are threatened by increasing salinity caused by evaporation and by pesticides used extensively in the area. Effects of sodium chloride, dimethoate and bayluscide on growth and chemical constituents of the freshwater chlorophyte Staurastrum boreale were studied. The calculated concentration of sodium chloride that inhibit 50% (EC50) of the growth, chlorophyll a and protein content are 0.52, 0.82, and 0.5 g/l, respectively, while that of the dry weight and carbohydrate content are 50% higher than that of the control at the highest concentration of sodium chloride of 1 g/l. The EC50 values of dimethoate are 14.2, 9.8, 15.8 and 8.7 mg/l for population growth, dry weight, chlorophyll a, protein, and carbohydrate content, respectively. For bayluscide, the EC50 values are 0.355, 0.37, 0.36, 0.275, and 0.37 mg/l for growth, dry weight, chlorophyll a, protein and carbohydrate, respectively. (Baker-IVI)
W85-06390

STUDIES ON THE ACUTE TOXICITY OF POLLUTANTS TO FRESHWATER MACROINVERTEBRATES, 2. PHENOL,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
D. W. J. Green, K. A. Williams, and D. Pascoe.
Archiv fur Hydrobiologie, Vol. 103, No. 1, p 75-82, March, 1985. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Toxicity, *Invertebrates, *Phenol, Water pollution effects, Organic compounds, Aquatic insects, Fish, Crustaceans, Mollusks, Arachnids.

Seven species of freshwater macroinvertebrate were exposed to a range of phenol concentrations using a continuous flow bioassay procedure. Considerable interspecific differences in sensitivity were observed. The most sensitive species tested was Baetis rhodani (96 hr LC50 15.5 mg phenol/l) and the most tolerant was Limnodrilus hoffmeisteir (96 hr LC50 780 mg/phenol). Results are in general agreement with a previously proposed order of increasing tolerance: fish to crustaceans to tolerant insects to worms to mollusks to highly tolerant insects to arachnids. There is evidence to suggest that some species may be more sensitive than previously tested fish or crustaceans. The modifying effects of water quality variables, particularly temperature, need further study. (Baker-IVI)
W85-06393

BIOCHEMICAL ALTERATIONS INDUCED IN FISH BY AN ACUTE KEROSINE-SPILLAGE,
Mainz Univ. (Germany, F.R.). Physiologisch-Chemisches Inst.
J. J. Stuber, and R. K. Zahn.
Archiv fur Hydrobiologie, Vol. 103, No. 1, p 117-127, March, 1985. 1 Fig, 3 Tab, 40 Ref.

Descriptors: *Kerosine, *Toxicity, *Fish, Water pollution effects, Trout, Organic compounds, Industrial accidents, Spills.

Three months after an acute aviation kerosine spillage followed by clean-up, exposed rainbow trout were investigated for induction level in mixed-function oxygenases (MFO) and deoxyribonucleic acid damage. For comparison trout kept in clean water yet in otherwise the same conditions were used as controls. The exposed specimens showed a threefold rise in MFO activity and a threefold increase of the absolute value of the slope factor characterizing the alkaline elution, signifying substantial DNA damage. In a discussion of the events triggered by the interaction of bioactive polycyclic aromatics, xenobiotics or allelochemicals, benzo(a)pyrene is used as a model substance. The evaluation of the events-chain in principle is possible with the analysis of many steps, however only a few are stable, reliable and long enough lasting to be practical. Among these few the MFO activities and the DNA damage have been chosen as these parameters represent biological damage potentials in a most obvious manner. The possible response to pollution impact in time is considered. The relative amount of DNA damage in relation to the MFO activity is the same for controls and exposed fish. (Baker-IVI)
W85-06394

SYSTEM FOR EXAMINING THE RESPONSE OF AQUATIC ECOSYSTEMS TO GRADUAL CHEMICAL INPUTS, AND FIELD APPLICATION IN OKEFENOKEE SWAMP, GEORGIA,
Georgia Univ., Athens. Inst. of Ecology.
J. D. Oliver.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 415-423, February, 1985. 2 Fig, 1 Tab, 17 Ref. NSF grants BSR 8114823 and BSR 8215587.

Descriptors: *Okefenokee Swamp, *Georgia, *Ecosystems, *Water pollution effects, Industrial wastes, Ammonia, Phosphates, Marshes, Nutrients.

A convenient standardized system for testing effects of chemical inputs on ecosystems in remote regions is described. Clear 2-m sq enclosures made of plastic film and steel fencing were placed in an Okefenokee Swamp marsh. Half of these enclosures contained 1 liter porous clay pots filled with 0.2M (NH4)2HPO4-enriched agar to simulate N and P fertilization by birds. Diel oxygen fluctuation, chlorophyll-a and total N and P concentrations in water were not significantly different in experimental mesocosms than in controls, but abundance of zooplankton was increased. In the laboratory, pots released an average of 45 mg NH4-N/d and 11 mg PO4-P/d into deionized water and more than this into Okefenokee black water. (Baker-IVI)
W85-06396

STUDIES ON THE ACUTE TOXICITY OF POLLUTANTS TO FRESHWATER MACROINVERTEBRATES; 1. CADMIUM,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
K. A. Williams, D. W. J. Green, and D. Pascoe.
Archiv fur Hydrobiologie, Vol. 102, No. 4, p 461-471, February, 1985. 1 Fig, 3 Tab, 32 Ref. EEC grant ENV.484.81.UK(H).

Descriptors: *Toxicity, *Cadmium, *Invertebrates, Water pollution effects, Aquatic insects, Crustaceans.

Information on the toxicity of compounds to macroinvertebrates can help in the determination of maximum permissible levels of pollutants that may be discharged into freshwater ecosystems. Acute toxicity tests (14 days) using a continuous-flow testing apparatus were conducted on ten species of freshwater macroinvertebrate. The median period of survival (LT50) for each species decreased with increasing cadmium concentration. Median lethal concentrations (24, 48 and 96 hour LC50's) calculated by indirect and direct methods indicated a wide range of species sensitivity. Members of the class Crustacea appeared extremely sensitive while insect species of the orders Plecoptera and Trichoptera exhibited high tolerance to cadmium poisoning in the short term. Considerable variation in sensitivity occurred within the Ephemeroptera. The most resistant species of all, the net-spinning caddis fly Hydropsyche angustipennis had a 96 hour LC50 value of 520 mg Cd/l, 26000.0 times greater than the corresponding value of 0.02 mg Cd/l, recorded for the most sensitive species, the freshwater shrimp Gammarus pulex. Four species had lower 96 hour LC50 values than that recorded for Salmo gairdneri. The results underline the importance of toxicity studies on invertebrates in establishing a broad toxicity data base for use in evaluating and regulating pollutant effects. (Moore-IVI)
W85-06399

STRIPED BASS MANAGEMENT IN LAKES WITH EMPHASIS ON MANAGEMENT PROBLEMS,
Kentucky Dept. of Fish and Wildlife Resources, Frankfort.
For primary bibliographic entry see Field 2H.
W85-06402

DECLINE OF STRIPED BASS IN THE SACRAMENTO-SAN JOAQUIN ESTUARY, CALIFORNIA,
California State Dept. of Fish and Game, Stockton.
D. E. Stevens, D. W. Kohlhorst, L. W. Miller, and D. W. Kelley.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 12-30, January, 1985. 15 Fig, 6 Tab, 39 Ref.

Descriptors: *Striped bass, *Sacramento-San Joaquin Estuary, *California, Fish populations, Reproduction, Water pollution effects, Mortality, Entrainment, Diversion, Estuarine fisheries, Fish food organisms, Plankton.

The abundance of young striped bass Morone saxatilis in the Sacramento-San Joaquin Estuary has suffered an unsteady but persistent decline from population levels that were high in the middle 1960's. The decline was particularly severe in 1977 and abundance of young striped bass has been low every subsequent year. The adult striped bass population also has fallen during the past 20 years, but the exact period over which the decline occurred and the rate of decline are not clear. The adult population is now about one-quarter of its former size and there is little sign of recovery. It is believed that the Sacramento-San Joaquin striped bass population and the fishery that it supports are in serious danger. The cause is most likely one or more of four factors. (1) The adult population is now so low that egg production may be inadequate. (2) The plankton food supply of young striped bass in the western Sacramento-San Joaquin Delta and Suisun Bay has been greatly reduced each spring. Diversion of water from the delta for agricultural purposes is a prime suspect for the decrease in food production. (3) Large numbers of young fish are lost by entrainment in water diversions. (4) The population is stressed by toxic substances such as petrochemicals and pesticides. Additional studies are underway to help determine the principal cause(s) of the striped bass decline. (Author's abstract)
W85-06403

STRIPED BASS, TEMPERATURE, AND DISSOLVED OXYGEN: A SPECULATIVE HYPOTHESIS FOR ENVIRONMENTAL RISK,
Oak Ridge National Lab., TN. Environmental Sciences Div.
C. C. Coutant.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 31-61, January, 1985. 12 Fig, 139 Ref. DOE contract DE-AC05-84OR21400.

Descriptors: *Striped bass, *Water temperature, *Dissolved oxygen, Fish populations, Fish stocking, Age, Fish behavior, Fisheries, Overfishing, Habitats.

Striped bass Morone saxatilis has a paradoxical record of distribution and abundance, including population declines in coastal waters and variable success of freshwater introductions. This record is analyzed for consistency with a hypothesis that striped bass are 'squeezed' between their thermal and dissolved oxygen preferences or requirements. A commonality among diverse field and laboratory observations supports an inherent thermal niche for the species that changes to lower temperatures as fish age. This shift can cause local conditions, especially warm surface strata and deoxygenated deep water, to be incompatible with the success of large fish. Crowding due to temperature preferences alone or coupled with avoidance of low oxygen concentrations can lead to pathology and overfishing, which may contribute to population declines. Through a mixture of evidence and conjecture, the thermal niche-dissolved oxygen hypothesis is proposed as a unified perspective of the habitat requirements of the species that can aid in its study and management. (Author's abstract)
W85-06404

INFLUENCES OF WATER QUALITY ON DISTRIBUTION OF STRIPED BASS IN A TENNESSEE RIVER IMPOUNDMENT,
Florida Game and Fresh Water Fish Commission, De Leon Springs.
T. E. Cheek, M. J. Van Den Avyle, and C. C. Coutant.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 67-76, January, 1985. 3 Fig, 35 Ref. Federal Aid in Fish Restoration Act project F-38, DOE contract DE-840R21400.

Descriptors: *Water quality, *Distribution, *Striped bass, *Watts Bar Reservoir, *Tennessee, Water temperature, Dissolved oxygen, Seasonal variation, Thermal pollution, Water pollution effects, Ecological distribution.

Telemetry techniques were used to evaluate relationships between water quality and distribution of adult striped bass Morone saxatilis during an 18-month period in Watts Bar Reservoir, Tennessee. Distribution and movements of fish were influenced by water temperature and dissolved oxygen concentration. During winter and early spring, temperature was vertically and horizontally uniform, and striped bass were relatively mobile and occurred in both tributary arms as well as in the main body of the reservoir. As the reservoir warmed in summer, fish were less mobile and progressively limited to areas in the tributary arms where temperature was less than 24 C and dissolved oxygen exceeded 4 mg/liter. Parts of the tributary arms of Watts Bar Reservoir provided such areas due to hypolimnetic discharges from upstream impoundments and groundwater inflows. Striped bass were restricted to these areas until late fall, when the entire reservoir cooled and again was nearly isothermal. Knowledge of relationships between striped bass habitat use and water quality is useful for fishery management and resource protection for reservoirs; an example is provided for Watts Bar Reservoir. (Author's abstract)
W85-06406

NUTRIENT ENRICHMENT OF CHESAPEAKE BAY AND ITS IMPACT ON THE HABITAT OF STRIPED BASS: A SPECULATIVE HYPOTHESIS,
Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W85-06409

TOXIC MATERIALS, FISHING, AND ENVIRONMENTAL VARIATION: SIMULATED EFFECTS ON STRIPED BASS POPULATION TRENDS,
National Fisheries Center-Leetown, Kearneysville, WV.
C. P. Goodyear.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 107-113, January, 1985. 1 Fig, 1 Tab, 28 Ref.

Descriptors: *Chesapeake Bay, *Fish populations, *Population dynamics, *Water pollution effects, Bays, Toxicity, Survival, Fishing.

Decreased survival of larval striped bass Morone saxatilis resulting from toxic chemicals in the environment and decreased survival of adults caused by fishing both are suspected as agents contributing to the decline in the Chesapeake Bay stock since the mid-1970's. The relative power of each type of mortality to cause population declines was evaluated with simulation techniques. Equivalent levels of added mortality induced qualitatively identical and quantitatively similar trends in population simulations for all conditions examined except if strong density-dependent mortality preceded in contaminant toxicity. In this case the contaminant effect caused a greater reduction in yield, but the population did not tend toward extinction. The results indicate that the observed downward trend in the Chesapeake Bay population can be halted or reversed by a reduction in fishing mortality, even if contaminant toxicity is the proximate cause for the decline. (Author's Abstact)
W85-06410

ACUTE AND CHRONIC TOXICITY OF ATRAZINE TO ESTUARINE FAUNA,
Environmental Science and Engineering, Inc., Gainesville, FL.
G. S. Ward, and L. Ballantine.
Estuaries, Vol. 8, No. 1, p 22-27, March, 1985. 4 Tab, 18 Ref.

Descriptors: *Water pollution effects, *Atrazine, Organic compounds, Herbicides, Estuaries, Toxicity, Invertebrates, Fish, Fauna.

Acute and chronic estuarine invertebrate and fish toxicity tests were conducted to evaluate possible consequences of measured concentrations of atrazine in estuarine areas. The 96-h LC50 values ranged from 0.094 mg per l for copepods to > 30 mg per l for larvae of eastern oysters. Maximum acceptable toxicant concentrations of $> 0.08 <$ 0.19 mg per l and $> 1.9 <$ 3.4 mg per l were determined by mysid shrimp and sheepshead minnows, respectively in life cycle and early life cycle tests. The approximate application factor limits in both tests were 0.1-0.2. Use of an application factor of 0.1 with the most sensitive species tested acutely provides a no effect concentration of approximately 0.009 mg per l for estuarine fauna. Therefore, the maximum reported measured concentration of approximately 0.002 mg per l atrazine in estuarine areas would not be suspected to adversely impact estuarine fauna. (Author's abstract)
W85-06413

EFFECTS OF COPPER ON PRODUCTION OF PERIPHYTON, NITROGEN FIXATION AND PROCESSING OF LEAF LITTER IN A SIERRA NEVADA, CALIFORNIA, STREAM,
Geological Survey, Menlo Park, CA.
H. V. Leland, and J. L. Carter.
Freshwater Biology, Vol. 15, No. 2, p 155-173, April, 1985. 9 Fig, 3 Tab, 48 Ref.

Descriptors: *Copper, *Litter, *California, *Nitrogen fixation, *Streams, *Periphyton, Population dynamics, Bacteria, Photosynthesis, Algae, Organic matter.

Production of periphyton, nitrogen fixation and processing of leaf litter were examined in Convict Creek, an oligotrophic Sierra Nevada stream and the responses of these processes to copper (2.5, 5, and 10 micro-g/liter total filtrable copper, T-Cu, which is approximately 12, 25, and 50 ng/liter Cu(2+)) were determined. Autotrophic production in Convict Creek was inhibited at 2.5 micro-g/liter T-Cu. The specific rate of photosynthesis of the mature community also declined at 2.5 micro-g/liter T-Cu. The results reflect a change in composition of the community during the year of exposure to an assemblage tolerant of copper. An increased tolerance to copper may have developed in some species during the year of exposure. Total production was inhibited at 2.5 micro-g/liter T-Cu, but the inhibition was more pronounced for autotrophic production than for heterotrophic production. The greater reduction in autotrophic production may reflect a narrower range in sensitivities to copper of autotrophic than of heterotrophic microorganisms. Nitrogenase activities of mature communities in Convict Creek were measured to assess the sensitivity of nitrogen-fixing blue-green algae to copper. Nitrogenase activity initially declined at 5 and 10 micro-g/liter T-Cu, but returned to control levels after 9 months of exposure. Nitrogenase activity did not vary consistently with population density of any of the common blue-green taxa. Reductions in microbial activity occurred at all test concentrations. (Baker-IVI)
W85-06414

EFFECT OF PHENOL ON THE PHOSPHOMONOESTERASES AND ATPASE ACTIVITY IN THE FISH SAROTHERODON MOSSAMBICUS (PETERS) IN SALINE WATERS,
Presidency Coll., Madras (India). Dept. of Zoolo-

gy.
S. Ravichandran, and B. Anantharaj.
Proceedings of the Indian Academy of Sciences, (Animal Sciences), Vol. 93, No. 6, p 557-563, October, 1984. 4 Tab, 21 Ref.

Descriptors: *Salinity, *Phenols, *Fish, *Water pollution effects, Toxicity, Enzyme activity, Adenosine triphosphate.

Effect of phenol at different salinities on the phosphomonoesterases and adenosine triphosphatase activity in the liver, muscle and brain of cichlid fish Sarotherodon mossambicus (Peters) is studied. Results indicate a general decrease in the activity of all the three enzymes assayed. The pattern of decrease shows a direct linear relationship with salinity and the toxicity is enhanced as salinity increases. It is possible that at higher salinities severe hydromineral imbalances are induced which further decrease the ability of the fish to combat the effect of the toxicant. Increased uptake of phenol is also possible at higher salinities. Salinity may therefore act as a contributory factor to phenol in increasing its toxicity and bringing about the observed higher inhibition of the enzyme activities. (Baker-IVI)
W85-06425

PROXIMATE COMPOSITION AND ORGANOCHLORINE AND HEAVY METAL CONTAMINATION OF EGGS FROM LAKE ONTARIO, LAKE ERIE AND LAKE MICHIGAN COHO SALMON (ONCORHYNCHUS KISUTCH WALBAUM) IN RELATION TO EGG SURVIVAL,
Guelph Univ. (Ontario). Dept. of Zoology.
P. F. Morrison, J. F. Leatherland, and R. A. Sonstegard.
Aquatic Toxicology, Vol. 6, No. 2, p 73-86, March, 1985. 8 Fig, 2 Tab, 28 Ref.

Descriptors: *Heavy metals, *Organochlorines, *Fish, *Great Lakes, *Lake Erie, *Lake Ontario, *Lake Michigan, Lakes, Toxicity.

A comparative study was made of the proximate composition and heavy metal and organochlorine content of coho salmon eggs collected from Lake Ontario, Lake Michigan and Lake Erie stock in 1981 and 1982 with the purpose of determining whether the poor survival of Lake Erie coho salmon eggs (24% compared with 78-86% in the other stocks) has a nutritional or toxicological etiology. Although there were marked interlake differences in egg ion, lipid, and protein content, the nutrient levels in the Lake Erie coho salmon eggs were similar to levels found in other egg stocks, and thus the poor survival does not appear to be related to gross nutrient deficiency; nor were the interlake differences in egg heavy metal or organochlorine residue levels consistent with a toxicological etiology for the high level of mortality of Lake Erie salmon eggs. (Author's abstract)
W85-06436

FREE RADICAL DERIVATIVES OF NITROGEN HETEROCYCLES IN LIVERS OF ENGLISH SOLE (PAROPHRYS VETULUS) WITH HEPATIC NEOPLASMS AND OTHER LIVER LESIONS,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
W. T. Roubal, and D. C. Malins.
Aquatic Toxicology, Vol. 6, No. 2, p 87-103, March, 1985. 7 Fig, 18 Ref.

Descriptors: *Water pollution effects, *Fish, *Duwamish River, *Seattle, *Washington, *Nitrogen compounds, Nitrogen, Organic compounds, Carbazole.

Free radicals of xenobiotics in liver microsomes of English sole (Parophrys vetulus) with hepatic neoplasms and other liver lesions were shown to be N-oxyl derivatives of nitrogen heterocycles. The fish were obtained from the highly polluted Duwamish River in Seattle, Washington State. The chemical structures of the free radicals were elucidated primarily by electron paramagnetic resonance (EPR) spectroscopy. Carbazole-9-oxyl was identified and other N-oxyl derivatives of nitrogen heterocycles also appeared to be present. Evidence showing that English sole are capable of forming nitroxyl free radicals from nitrogen heterocycles was obtained when carbazole was administered via injection into the caudal vein: that is EPR spectroscopy of bile and lyophilized liver microsomes showed the presence of carbazole-9-oxyl. The evidence for the formation of N-oxyl derivatives in the English sole liver is of interest in regard to the etiology of hepatic lesions in fish. (Author's abstract)
W85-06437

PHOTOENHANCED TOXICITY OF ANTHRACENE TO JUVENILE SUNFISH (LEPOMIS SPP.),
Michigan State Univ., East Lansing. Center for Environmental Toxicology.
J. T. Oris, and J. P. Giesy, Jr.
Aquatic Toxicology, Vol. 6, No. 2, p 133-146, March, 1985. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Fish, *Toxicity, *Pesticides, *Anthracene, Organic compounds, Ultraviolet radiation, Hydrocarbons.

The acute toxicity of anthracene to juvenile sunfish (Lepomis spp.) in the presence of simulated sunlight has been assessed. Previously, anthracene was considered not to be acutely toxic to fish. However, in this study 96 h LC50 values were found to be 190-1800-times less, with concurrent exposure of anthracene and simulated sunlight, than a reported 24-h no-effect anthracene concentration for L. macrochirus derived under standard laboratory conditions. Opercular ventilation rate was significantly increased in UV light-anthracene treated fish, and histological evidence indicated that major structural changes occurred in the gills of these fish as compared to UV light-only controls. The site of toxic action does not appear to be limited to respiratory surfaces, however, since dorsal epidermal structure was also disrupted in UV light-anthracene treated fish as compared to UV light-only controls. A mathematical relationship to estimate the potential of anthracene to fish is presented which closely predicts the results of toxicity studies conducted under natural sunlight. It is concluded that solar radiation is an important accessory parameter that deserves consideration in the toxicity assessment of polycyclic aromatic hydrocarbons in the aquatic environment. (Author's abstract)
W85-06439

USE OF FISH CELL CULTURES AS AN INDICATION OF CONTAMINANT TOXICITY TO FISH,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W85-06440

RETROSPECTIVE ASSESSMENT OF A POTENTIAL CADMIUM HAZARD,
Akron Univ., OH. Dept. of Geology.
B. M. Manner, R. F. Lee, and R. G. Corbett.
Ohio Journal of Science, Vol. 85, No. 1, p 12-16, March, 1985. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Fish, *Toxicity, *Cadmium, *Accidents, *Ravenna, *Ohio, *West Branch Reservoir, Water pollution effects, Metals.

In 1968 an accidental discharge of cadmium plating solution caused a significant fish kill near Ravenna, Ohio. Water (130 samples) from West Branch Reservoir in 1971 and 1973 contained up to 0.055 mg/l cadmium, and fish (nine species, muscle tissue) contained up to 0.34 mg/kg. As a control, water and fish were sampled from Nimisila Reservoir. Cadmium was not detected in water (eight samples, 0.001 mg/l detection limit) and was detected in only one of eight species of fish (0.21 mg/kg). There is a delicate balance of responsibility between concern for public health or safety and the need for conclusive data in assessing and announcing a potential hazard. Water samples from West Branch Reservoir exceeded the drinking water standard of 0.01 mg/l, but it was not used as a public source. All fish sampled from West Branch Reservoir contained measurable cadmium, but no standard had been set. Under these circumstances one could not clearly assess the hazard. In 1979, the Environmental Protection Agency (EPA), in developing guidelines for application of sewage sludge to agricultural lands, concluded that 70 microg per day cadmium is a reasonable maximum dietary intake. The possibility of an imminant hazard was investigated. Consumption of 227 g of fish (muscle tissue, average of seven species) would have resulted in an increase of 45 microg cadmium per day; 227 g of carp (Cyprinus carpio) (muscle tissue, highest value) in an increase of 77 microg cadmium per day. Added to the estimated of 39 microg per day dietary intake of cadmium, each situation exceeded the recently set 70 microg/day limit. Because the EPA standard is set low (allowing for the equivalent of 75 microg/day intake by heavy smokers plus 55 microg/day as a safety margin between the limit and the minimum at which damage occurs), the occasional consumption of fish would not have represented a major hazard. (Author's abstract)
W85-06448

RELATION BETWEEN CERTAIN COMPONENTS OF PLANKTONIC COMMUNITY AND THE CONTENT OF PHOSPHATES AND OXYGEN IN WATER (VZAIMOSVYAZI MEZHDV NEKOTORYMI KOMPONENTAMI PLANKTONNOGO SOOBSHCHESTVA I SODERZHANIEM FOSFATOV I KISLOROBA V VODE),
For primary bibliographic entry see Field 2H.
W85-06459

TOXICITY OF CONDENSATE FROM POLYESTER II-520 PRODUCTION FOR DAPHNIA MAGNA STRAUS AND ITS EFFECT ON SELF-PURIFICATION (TOKSICHNOST' KONDENSATA OT PROIZVODSTVA POLIEFIRA P-520 DLYA DAPHNIA MAGNA STRAUS I EGO VLIYANIE NA PROTSESSY SAMOOCHISHCHENIYA),
L. I. Chuprina, S. I. Elbaum, L. I. But, N. I. Avdeeva, and N. I. Mikhaleva.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 58-61, 1984. 1 Fig, 10 Ref.

Descriptors: *Water pollution effects, *Industrial wastewater, Bacteria, Self-purification, Water fleas, Plankton, Chemical oxygen demand, Daphnia, Crustaceans.

Water bodies were studied to determine an admissible content of condensate from polyester II-520 production. The harmful effects of the condensate on the self-purification of water bodies was studied with special attention given to its influence on the vital activities of water fleas, bacteria, plankton biocenosis and hydrochemical regime. The condensate concentration of 0.9-14.4 mg oxygen/l by chemical oxygen demand (COD) had a sublethal effect on copepods. The the highest concentration found, (14.4 mg oxygen/l by COD) increased the 5-day biochemical oxygen demand by 12%. A concentration of 0.45 mg oxygen/l by COD may be considered harmless, as it gives results similar to those obtained with controls. (Author's abstract)
W85-06461

EVALUATION OF SAPROBIC CHARACTER OF CERTAIN SMALL RESERVOIRS OF THE UKRAINE FOR PHYTOPLANKTON (OTSENKA SAPROBNOSTI NEKOTORYKH MALYKH VOVOKHRANILISHCH UKRAINY PO RITOPLANKTONU),
R. P. Zhupanenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 3, p 46-49, 1984. 1 Tab, 11 Ref.

Descriptors: *Ukraine, *USSR, *Reservoirs, *Phytoplankton, Algae, Bioindicators, Water pollution effects, Saprobity, Seasonal variation.

Reservoirs created in basins of the small rivers of the Ukraine (the Seversky Donets, Ingul and the Berda. Mius and Kalmius flowing into the Sea of Azov) are estimated for their saprobic character, making use of phytoplankton and comparing a list of algae found in the reservoirs under study with a

list of pollution indicating species, determining saprobic index and saprobic valency. The seasonal and water area saprobic character is determined for the Pechenezhsky, Krasnooskolsky, Lozovenkovsky, Sugokleevsky, Berdyansky, Grabovsky and Verkhne-Kalmiussky reservoirs. (Author's abstract)
W85-06475

FISH SUFFOCATION IN LAKE NAINITAL (INDIA) CAUSED BY POLLUTION AND PARASITE INFECTION (GIBEL'RYB V OZERE NAINITAL (INDIYA) V REZUL'TATE ZAGRYAZNENIYA I ZARAZHENIYA PARAZITAMI),
S. M. Das, and A. K. Shrivastava.
Gidrobiologischeski Zhurnal, Vol. 20, No. 4, p 58-63, 1984. 3 Tab, 12 Ref.

Descriptors: *Mortality, *Fish, *Water pollution effects, *Lake Nainital, *India, Seasonal variation, Fish parasites, Organic matter, Ammonia, Hydrogen sulfide, Methane.

The paper deals with reasons for high fish mortality in Lake Nainital, Kuman, India. High early winter mortality (December-January) is shown to be caused by increased content of pollutants (such as DOM, SOM, NH3, H2S and methane) in the lake water. The lake, however remains somewhat polluted throughout the year. Early spring mortality (February-March) is shown to be due to an extensive attack by parasites. The physicochemical hazards of environmental pollution to fish of the lake, actual mortality caused by them, and parasites causing fish mortality are discussed. (Author's abstract)
W85-06478

EFFECTS OF TEMPERATURE ON THE LOCOMOTOR ACTIVITY OF THE BLUEGILL SUNFISH, LEPOMIS MACROCHIRUS,
Tulane Univ., New Orleans, La. Dept. of Biology.
A. A. Malizia, Jr., K. S. Bloom, and E. G. Ellgaard.
Louisiana Academy of Sciences, Vol. 47, p 10-14, December, 1984. 2 Fig, 8 Ref.

Descriptors: *Fish behavior, *Temperature effects, *Heat stress, *Bluegill, Thermal pollution, Heated water, Kinetics, Locomotor activity.

Laboratory conditions have been established that permit a group of bluegill to demonstrate kinetic behavior analogous to an opposed first-order chemical reaction. The locomotor activity of the bluegill approximated an opposed first order reaction at all temperatures examined. Locomotor activity, which increased with temperature over the range of 4 to 32 C used in this study, is also temperature dependent. It is not directly proportional throughout the entire range. From 4 to 8 C activity increases 100-fold, because fish at 4 C are virtually motionless. In the range from 8 to 26 C locomotor rates double with the temperature increase of 10 C, suggesting the locomotor activity of the bluegill may be governed mainly by changes in metabolic rate under the influence of temperature. From 26 to 32 C the locomotor rates double when the temperature is increased about 2 C, which is seen as a behavioral reaction to stress. Extension of these studies to derive similar descriptions for bluegill acclimated to other temperatures would provide a complete profile for locomotor activities of the fish. These could be used to determine whether the swimming behavior of bluegill in different temperature zones has been altered to any measurable extent. (Baker-IVI)
W85-06487

RELATIONSHIPS BETWEEN CARBON AND CADMIUM UPTAKE IN MYTILUS EDULIS,
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
T. Borchardt.
Marine Biology, Vol. 85, No. 3, p 233-244, March, 1985. 5 Fig, 5 Tab, 39 Ref.

Descriptors: *Mussels, *Carbon, *Cadmium, Radioisotope tracers, Food, Growth, Shells, Carbon radioisotopes, Cadmium isotopes, Metabolism, Water pollution effects.

The influence of six different food rations on carbon assimilation and net incorporation, and on shell and soft body growth in Mytilus edulis was determined over a 75-d period, starting in 1981. Using a triple tracer technique, interrelationships between carbon net incorporation (C-14) and cadmium accumulation from food (Cd-109) and seawater (Cd-115m) were investigated. With decreasing food rations there was an exponential increase of the carbon assimilation efficiency from 35 to 76% while the net incorporation efficiency increased approximately linearly, ranging from 15 to 32% at the highest and lowest food supply levels respectively. The carbon assimilation efficiency adapted to new conditions within 1 to 2 d while the adaptation of the net incorporation efficiency took about one month. Shells kept growing, even when the soft body lost weight. Within a 42-d elimination period, when the soft body lost 58% of the incorporated carbon, nothing was released from the shells. Cadmium accumulation from food was closely interrelated with carbon net incorporation and exhibited the same uptake kinetics. No homogeneity was found between carbon net incorporation and cadmium accumulation from seawater, and between the elimination of carbon and cadmium. (Author's abstract)
W85-06521

EFFECT OF ENVIRONMENTAL PARAMETERS ON LYSOSOMAL MARKER ENZYMES IN THE TROPICAL BLOOD CLAM ANADARA GRANOSA,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
S. Patel, and B. Patel.
Marine Biology, Vol. 85, No. 3, p 245-252, March, 1985. 4 Fig, 6 Tab, 30 Ref.

Descriptors: *Clams, *Enzymes, *Bioindicators, Animal physiology, Water pollution effects, Seasonal variation, Salinity, Temperature effects, Indicators..

The lysosomal marker enzymes, arylsulfatase and acid phosphatase, in a tropical burrowing arcid clam Anadara granosa L. have been found to exhibit seasonal variations. The activity of both enzymes decreased with increase in ambient temperature and fell with increase in salinity. Lysosomal latency for these enzymes, however, was not significantly affected by environmental parameters, including salinity, temperature, nutritional status, breeding season, etc. The physico-chemical characteristics of the habitat were found to induce reversible changes in the lysosomal latency and enzyme activity. Exposure to elevated temperature (Delta T = 7 to 8 C), towards the upper limit of its physiological tolerance, was found to labilize the lysosomes. The biochemical methods optimized for the demonstration of lysosomal stability under exposure to environmental stressors could also be extended to quantify the impact of various pollutants, including heavy metals, radionuclides, etc. at the subcellular level. (Author's abstract)
W85-06522

LEAD IN WATER, INFANT DIET AND BLOOD: THE GLASGOW DUPLICATE DIET STUDY,
Water Research Centre, Marlow (England).
R. F. Lacey, M. R. Moore, and W. N. Richards.
Science of the Total Environment, Vol. 41, No. 3, p 235-257, March, 1985. 6 Fig, 9 Tab, 11 Ref.

Descriptors: *Glasgow, *Scotland, *Drinking water, *Lead, *Water pollution effects, Blood, Infants, Public health, Heavy metals, Water quality, Plumbing.

The Glasgow Duplicate Diet Study was a study of the concentration of lead in the blood of Glasgow babies in relation to their predominant source of dietary lead, water drawn through domestic plumbing. The aim of the study was to offer guidance on the allowable concentration of lead in drinking water. The statistical analysis of the data yielded several consequences. It confirmed the overall consistency of the water and diet-lead samples and the harmonization of the two analytical laboratories involved in that work. The contribution of lead from the solid component of baby foods was statistically detectable but of negligible proportion compared with water-lead. The results gave scaling factors which may be useful in comparing this work with studies based on other types of sample. It was possible to screen the data for individual anomalies which might otherwise have distorted later results. Estimates of the coefficient of variation for sampling variability were made available for later use. While more information than had even been available before is presented concerning the relationship between ingested water lead and blood lead for infants of around 3 months of age, this information still has a large amount of unexplained variation which leaves uncertainty not only in the quantitative estimates of the parameters of the relationship but also in its qualitative form. (Baker-IVI)
W85-06548

DNA DAMAGE BY BENZO(A)PYRENE IN THE LIVER OF MOSQUITO FISH GAMBUSIA AFFINIS,
Institut Rudjer Boskovic, Rovinj (Yugoslavia). Centar za Istrazivanje Mora.
R. Batel, N. Bihari, B. Kurelec, and R. K. Zahn.
Science of the Total Environment, Vol. 41, No. 3, p 275-283, March, 1985. 2 Fig, 2 Tab, 32 Ref.

Descriptors: *Mosquito fish, *DNA, *Water pollution effects, *Benzo(a)pyrene, Fish, Aromatic compounds, Hydrocarbons, Enzymes,.

Specimens of a laboratory population for the mosquito fish Gambusia affinis raised in charcoal-filtered tap water at 23 C with 1.5-2.0 g body weight and a liver weight up to 1.5 mg were exposed to 0.1 mg/ml benzo(a)pyrene (BaP) in methanol. In order to establish possible differences in the basal activity of benzo(a)pyrene monooxygenase (BPMO) between sexes, three groups of fish were analyzed: males, females and pregnant females. Exposure of fish to BaP-polluted water produced an increase in BPMO activity with a maximum after 48 hr. This increase in the groups exposed to 1, 10, and 100 ppb BaP is significant. After 2 days of exposure to 1, 10, and 100 ppb BaP, G. affinis significantly increased its liver BPMO activity. Simultaneously, a statistically significant change in the lengths of DNA treated with nuclease S1 can be detected. The coexistence of microsomal MFO activities and of DNA damage indicates that: DNA damage accumulates by the production of damaging species originating from mixed function oxidases metabolism of BaP; and it mirrors a momentary situation in a dynamic stage during which BaP-derivatized electrophilic products are generated that alter DNA, and the DNA alterations are repaired at a different rate. (Baker-IVI)
W85-06550

RELATIONSHIP BETWEEN SERUM ENZYMES, HISTOLOGICAL FEATURES AND ENZYMES IN HEPATOPANCREAS AFTER SUBLETHAL EXPOSURE TO MALATHION AND PHOSPHAMIDON IN THE MURREL CHANNA STRIATUS (BL.),
Burdwan Univ. (India). Dept. of Zoology.
A. K. Sadhu, D. K. Chowdhury, and P. K. Mukhopadhyay.
International Journal of Environmental Studies, Vol. 24, No. 1, p 35-41, 1985. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Insecticides, *Fish, *Water pollution effects, *Toxicity, Malathion, Phosphamidon, Organic compounds, Agricultural chemicals, Pesticide toxicity, Enzymes.

The effects of 10 day pesticide exposure of Channa striatus at two sublethal levels (0.1 and 0.2 ppm for malathion; 2.5 and 5 ppm for phosphamidon) on the activities of phosphatases and transaminases in hepatopancreas and blood serum were investigated. Hepatic cells of the whole tissues exposed to 0.1 ppm malathion showed marked precipitation of both cytoplasmic and nuclear material in some cells and a few were completely vacuolated. Similar degeneration was noted in fish exposed to 2.5

ppm phosphamidon with a lower degree of necrosis in the tissue structure. The extent of damage in the hepatopancreatic tissue was severe at higher concentrations. Acid phosphatase and alkaline phosphatase activity in fish following malathion and phosphamidon exposures show marked decrease in their activities in hepatopancreas with concomitant increase in their activities in the blood serum. Phosphamidon exposure resulted in insignificant changes both in hepatopancreas and serum at low doses, while at higher dose increase in enzyme activities were noted. (Baker-IVI)
W85-06557

FISH COMMUNITIES OF MIDWESTERN RIVERS: A HISTORY OF DEGRADATION,
Smithsonian Tropical Research Inst., Balboa (Panama).
J. R. Karr, L. A. Toth, and D. R. Dudley.
BioScience, Vol. 35, No. 2, p 90-95, February, 1985. 4 Fig, 1 Tab, 33 Ref. EPA grants G00513, R-806391, CR-810745, and CR-807677.

Descriptors: *Fish, *Water pollution effects, *Water quality control, *Illinois River, *Maumee River, Fish populations, Water quality, Water resources management, Conservation, Habitats.

As human populations have grown, water resource quality has declined. Since 1850, 67% of the fish species from the Illinois River and 44% from the Maumee River have become less abundant or have disappeared. Reversing such trends demands innovative approaches to water resource management. Such an approach must address the five primary variables and their components that affect the integrity of stream biota: energy source (allochthonous organic matter vs. primary production in the stream, particle size distribution of particulate organics); water quality (temperature, turbidity, dissolved oxygen content, soluble organics and inorganics, heavy metals, toxic substances); habitat structure (bottom type, water depth, current velocity, availability of appropriate habitats for diverse needs); flow regime (water volume, temporal distribution of water availability, flood frequency); and biotic interaction (competition, predation, disease, and parasitism). (Baker-IVI)
W85-06565

ACID TOLERANCE IN AMPHIBIANS,
Baylor Univ., Waco, TX. Dept. of Biology.
B. A. Pierce.
BioScience, Vol. 35, No. 4, p 239-243, April, 1985. 1 Tab, 38 Ref.

Descriptors: *Amphibians, *Acidity, *Water pollution effects, Acid rain, Frogs, Salamanders, Immature growth stages, Seasonal variation.

Amphibian acid tolerance is a multifaceted phenomenon influenced by taxonomic, geographic, environmental, ecological, and genetic factors. Amphibians as a group appear to be relatively acid tolerant, with many species capable of surviving in acidic solutions of pH 4-4.5. But some species, like the spotted salamander and the leopard frog, are much more sensitive to acid conditions. Acidity can slow growth and produce developmental abnormalities at much higher pH. Thus some amphibian populations will likely be severely damaged by increases in environmental acidity, increases that may occur through atmospheric acid deposition or other anthropogenic sources. Those species that breed in naturally more acidic conditions appear to be more resistant to acid, suggesting that natural selection has shaped these interspecies differences. Those species breeding in alkaline environments would appear then to be particularly vulnerable to any acidification of their habitats. Fertilization is the developmental stage most sensitive to acidity, and toxic effects of low pH are also important in embryonic stages. Larvae tolerate acidity better than embryos, and tolerance increases with age. Since the ability to withstand low pH depends on age and developmental stage, seasonal changes in acid deposition must be considered in assessing effects of acidification on natural populations. (Baker-IVI)
W85-06566

EFFECTS OF FORESTRY ON WATER QUALITY AND FISH IN WELSH RIVERS AND LAKES,
Welsh Water Authority, Powys (Wales).
J. H. Stoner, and A. S. Gee.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 1, p 27-45, February, 1985. 8 Fig, 6 Tab, 53 Ref.

Descriptors: *Water quality, *Forestry, *Fisheries, *Wales, Lake Syfydrin, River Camddwr, Lake Craig y Pistyll, River Tywi, Seasonal variation, Sulfates, Nitrates, Calcium, Chlorides, Environmental effects, Acidification, Land use.

Processes affecting water acidification are described and the current water quality and fishery status of some upland streams, rivers and lakes in Wales are considered. Chloride concentrations, derived almost exclusively from the sea, were elevated by 11.71% in afforested streams and lakes compared with equivalent moorland catchments. Sulfate concentrations were elevated by 19% in the river Tywi and catchments, Sulfate concentrations were elevated by 19% in the river Tywi and 106% in Lake Syfydrin compared with the unafforested river Camddwr and Lake Craig y Pistyll. Mean annual excess sulfate concentrations of 102 micro equiv/l in the river Tywi and 265 micro equiv/liter in Syfydrin were elevated by 21% and 117% respectively compared with those in their adjacent moorland catchments. No significant difference was found beween sulfate or excess sulfate levels in the afforested Blaenmelindwr and Pendam lakes compared with Thosgoch. Nitrate concentrations typically showed summer minima and winter maxima, but sulfate showed no consistent seasonal trend. Concentrations of calcium varied little with season, but aluminium and hydrogen ion levels were significantly elevated in the winter months in afforested systems. Apart from chloride, the major anions in both lakes and streams were sulfate and nitrate. Elevation in hydrogen and aluminium are therefore likely to be governed by concentrations of these anions and the availability of calcium and magnesium. At calcium concentrations below 100 micro equiv/liter and pH levels in the range 4.5-5.5 elevated aluminium concentrations prevent adequate ionic regulation by the gills leading to death from ionic stress and asphyxia. (Baker-IVI)
W85-06574

SYNERGISTIC EFFECTS OF ACIDITY AND ALUMINUM ON FISH (GOLDEN SHINERS) IN LOUISIANA,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
J. W. Robinson, and P. M. Deano.
Journal of Environmental Sciences and Health, Vol. A20, No. 2, p 193-204, February, 1985. 8 Fig, 6 Ref.

Descriptors: *Shiners, *Aluminum, *Acidity, *Synergism, *Louisiana, Mortality, Water pollution effects, Toxicity, Clay, Aluminum silicate, Decomposition, Leaves.

The effects of acidity on the mortality of fish (golden shiners) was studied at pH 3.7, 4.5, 5.0, 7.0, and 7.8, under controlled laboratory conditions. Results showed at pH 3.7 all fish died rapidly. As the acidity decreased, the rate of loss of fish decreased. At pH 4.5 they lived about 3 weeks and they survived pH 5.0. Aluminum was added to freshwater tanks as Al2(SO4)3 and the pH of the tank adjusted slowly as necessary to avoid localization of the acid. The tanks were then allowed to equilibrate and 20 fish placed in each tank. At pH 4.5 and 5.0 plus 100 ppm aluminum, all fish died within a few hours. With total aluminum concentrations of 10 ppm and 100 ppm and pH 4.5 and pH 5.0 it appeared that the aluminum and the acid had a synergistic toxic effect. Visual inspection of the fish showed the aluminum interacted with the gills, which may have caused suffocation. It is possible that some chemical forms of aluminum are more toxic than others. Suspended clay (aluminum silicate) does not appear to be toxic, but in acid solution aluminum ion is released which may be toxic. In other studies using nuclear magnetic resonance, data suggested an interaction of the decomposition products of leaves with aluminum in aqueous media possibly neutralizes the toxic form. These preliminary observations indicate the feasibility of eliminating aluminum toxicity and invite further studies. (Author's abstract)
W85-06599

ROAD SALT CONTAMINATES WELL, CAUSES HEALTH HAZARD,
For primary bibliographic entry see Field 5B.
W85-06611

EFFECT OF ACID PRECIPITATION ON SOIL MICROBIAL ACTIVITY: I. SOIL CORE STUDIES,
Florida Univ., Gainesville. Lab. of Environmental Microbiology.
G. Bitton, and R. A. Boylan.
Journal of Environmental Quality, Vol. 14, No. 1, p 66-69, January/March, 1985. 3 Tab, 29 Ref.

Descriptors: *Acid rain, *Soil microbial activity, Acid precipitation, Water pollution effects, Hydrogen ion concentration, Soil chemistry, Enzymes, Soil respiration, Carbon dioxide, Nitrogen fixation.

The effect of acid precipitation on selected microbial processes was studied in soil cores. Candler, Pomona and Apopka soils were used in the short-term column study. Three different soils were used in the long-term study: two sandy soils (Eustis and Candler) and a histosol (Okeechobee). Following short-term (92 d) exposure of soil cores to acid rain at pH 3.7 and 3.0, no alteration in enzyme activities was observed. The effect on soil respiration was dependent on soil type. Acid precipitation did not significantly affect soil respiration in Candler soil. Dinitrogen fixation was reduced only in Apopka soil by the rain at pH 3.0. Following long-term (690 d) exposure to acid rain, alterations in enzyme activities and CO2 evolution were dependent on the soil type. There was no difference in the pH of treated and control Okeechobee soils, but a reduction in pH between the control and acidified soils was observed in both Eustis and Candler soils. No reduction in adenosine triphosphate (ATP) content or N2 fixation were observed. (Moore-IVI)
W85-06618

EFFECT OF ACID PRECIPITATION ON SOIL MICROBIAL ACTIVITY: II. FIELD STUDIES,
Florida Univ., Gainesville. Dept. of Environmental Engineering.
G. Bitton, B. G. Volk, D. A. Graetz, J. M. Bossart, and R. A. Boylan.
Journal of Environmental Quality, Vol. 14, No. 1, p 69-71, January/March, 1985. 3 Tab, 22 Ref.

Descriptors: *Acid rain, *Soil microbial activity, Lake McCloud, Florida, Acid precipitation, Enzymes, Microorganisms, Nitrification, Soil chemistry, Water pollution effects, Soil respiration.

A field study on the impact of acid rain upon microbiological processes was carried out near Lake McCloud, Florida. The study site was composed of three transects, each including three plots. Each transect was spray-irrigated with lake water at pH 3.0, 3.7, or 4.6 (the lake water has a natural pH of 4.6). The soil of the lake watershed was Candler, a Typic Quartzipsamment. Acid rain did not significantly reduce dehydrogenase, phosphatase, or urease activity; protease activity was decreased. Soil respiration was not altered by acid rain of pH 3.7 or 3.0. Acid rain significantly reduced nitrification at both pH levels. Nitrification in soil was the most sensitive to acid precipitation under field conditions at a Florida site. (Moore-IVI)
W85-06619

OXYGEN CONCENTRATION OF WATERS OF THE FELDBERGER LAKE DISTRICT ON THE BASIS OF SELECTED SUMMER DEPTH PROFILES FROM 1924 THROUGH 1962. PART 2: ZANSEN, WOOTZEN, CARWITZER LAKE, DREETZ AND KRUSELIN (ZUM SAUERSTOFFHAUSHALT DER GEWASSER DER FELDBERGER SEENPLATTE AN HAND AUSGEWAHLTER SOMMERLICHER TIEFEN-

PROFILE SEI 1924 RZW. 1962, TEIL 2: ZANSEN, WOOTZEN, CARWITZER SEE, DREETZ UND KRUSELIN),
Bonito A.G., Osterburg (German D.R.).
For primary bibliographic entry see Field 2H.
W85-06652

CLASSIFICATION OF WATER COMPONENTS ACCORDING TO THEIR POTENTIAL TOXICITY TO WATER ORGANISMS (DIE KLASSIFIZIERUNG VON WASSERINHALTSSTOFFEN NACH IBREM TOXIZITATSPOTENTIAL GEGENUBER WASSERORGANISMEN),
Bezirksinstitut fuer Veterinarwesen Karl-Marx-Stadt (German D.R.). Abt. Fischkrankheiten.
K. Grahl.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 137-143, 1983. 4 Tab, 12 Ref.

Descriptors: *Toxicity, *Classification, *Water pollution effects, Growth stage, Fish, Water chemistry.

A new system of classification is presented to describe the potential toxicity of substances contained in water to water organisms; it is based on the concept of EC50, in which E means effect, so that EC50 is the concentration of a substance in mol/l which has the same toxic effect on an organism at the same stage of development under defined test conditions. The use of mol/l results in very small measurements, so for the sake of clarity, the negative log of EC50 is used to describe toxic potential (pEC50). This system allows components of water to be classified according to increasing toxicity in the form of an open-ended scale beginning at zero: pEC50 values from 0 to 3 mean that the substance is non- or slightly toxic; values > 5 signify danger to aquatic organisms; while values of > or = 7 indicate extreme toxicity. The system seems to eliminate the relatively great spread of toxicity measurements resulting from biological testing when such testing is not carried out with completely consistent boundary conditions. pEC50 values are not constants, but are species-specific in the context of given test conditions. Verbal descriptions of toxicity that are customary in other classification systems become unnecessary with the pEC50 system. Rounding of pEC50 values to one decimal point is recommended when toxic potential has been measured under varying test conditions for a species or a group of species, e.g., sensitive fish; rounding to two points is recommended for different substances under approximately similar test conditions for one species at the same developmental stage and for testing of one substance under similar conditions for a species at various development stages. Tables are given showing the results of these types of testing. A tabular comparison of the pEC50 scale with previously published classification systems is also presented. (Collier-IVI)
W85-06657

ACUTE TOXICITY OF CARBAMIDE AND ITS LONG TERM EFFECTS ON THE GROWTH OF FINGERLINGS OF A TROPICAL FRESH WATER TELEOST, COLISA FASCIATUS (BLOCH AND SCH.),
Gorakhpur Univ. (India). Dept. of Zoology.
K. Pandey, and J. P. Shukla.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 145-149, 1983. 2 Tab. 20 Ref.

Descriptors: *Toxicity, *Carbamide, *Fish, Growth, Water pollution effects, Fish behavior, Mortality, Organic compounds.

Normal, healthy Colisa fasciatus fingerlings were exposed to LC0, LC50 or LC100 values of carbamide (urea) for 24, 48, 72, or 96 hr. The safe concentration of carbamide for a long term exposure was 2.5 mg/l. The toxic tolerance range of carbamade was 3.0 to 4.5 mg/l. The behavioral response of fingerlings toward carbamide was grossly dependent on concentration and length of exposure. When fingerlings were exposed to higher concentrations of carbamide, hyperexcitability and increased air-gulping were observed. Fingerlings were often observed swimming fast. Mucus secretion was also increased with increased exposure. The closer examination of dead fingerlings showed open opercula, sometimes bent bodies and whitish gills with copious mucus. The growth of the fingerlings showed no appreciable change in urea stress till the 11th day, while a gradual fall in their weight became obvious only from the 12th day. A significant decline in length was noted after the 7th day. (Baker-IVI)
W85-06658

TOXICITY OF SIMPLE AND COMPLEXED CYANIDE TO AQUATIC ORGANISMS (ZUR TOXIZITAT EINFACHER UND KOMPLEXER CYANIDE GEGENUBER WASSERORGANISMEN),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
M. Tscheu-Schluter.
Acta Hydrochimica et Hydrobiologies, Vol. 11, No. 2, p 169-179, 1983. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Toxicity, *Cyanide, *Aquatic life, Heavy metals, Cyanide compounds, Guppies, Chlorophyta, Photolysis, Hydrogen ion concentration, Water pollution effects.

The toxic effects of alkali cyanide, complex cyanide-containing heavy metal salts (of iron, cadmium, copper, nickel and mercury) were investigated according to standard methods with the aid of the test organism Poecilia reticulata (guppy) as well as the green alga Ankistrodesmus falcatus (beta- to alpha-mesosaprobic). Since various complex compounds can be photolytically decomposed, discontinous light-dark phases were also used. As discussed equilibrium calculation have shown, inter alia also the pH-value is important in the fish organism used, with different reactions to ions and molecularly dissolved compounds. The results are summarized in tables and graphic representations, the substances investigated being classified into groups by the strength of the toxic actions. (Author's abstract)
W85-06660

INFLUENCE OF TEMPERATURE ON THE TOXICITY OF PHENOL AND ITS CHLORO- AND NITRO-DERIVATIVES TO THE FISH NOTOPTERUS NOTOPTERUS (PALLAS),
S. Gupta, R. C. Dalela, and P. K. Saxena.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 2, p 187-192, 1983. 3 Tab, 21 Ref.

Descriptors: *Toxicity, *Fish, *Water pollution effects, *Phenols, Temperature effects, Pentachlorophenol, Dinitrophenol, Organic compounds.

Active and healthy specimens of Notopterus notopterus exhibited four phases of intoxication on exposure to phenols: pronounced motor activity, loss of equilibrium, convulsions, total loss of locomotor activity followed by death attributable to nerve poisoning and paralysis. Fish also secreted an excessive mucus from the skin, possibly to minimize the irritating effects of the chemicals. With decreasing temperature, the toxicity of the individual substances decreased by 6.5 to 22%, that of the mixtures by 10 to 87%. With rising temperature, the toxicity increased by 38-747% and 75 to 744%, respectively. The safety limits at 23 C lie between 0.3 micro-g/l for a synergistically acting mixture and 0.9 mg/l for an antagonistically acting one. For the individual substances this range is 3.5 micro-g/l to 0.5 mg/l. (Baker-IVI)
W85-06661

SEDIMENT AND NUTRIENT EXPORT IN RUNOFF FROM BURNED AND HARVESTED PINE WATERSHEDS IN THE SOUTH CAROLINA PIEDMONT,
Clemson Univ., SC. Dept. of Forestry.
For primary bibliographic entry see Field 5B.
W85-06714

LABORATORY INVESTIGATION OF LEACHATE CHEMISTRY FROM SIX APPALACHIAN FOREST FLOOR TYPES SUBJECTED TO SIMULATED ACID RAIN,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 2K.
W85-06721

EFFECT OF SOME COAL GASIFICATION AND TAR SAND PROCESS WATERS ON THE VIABILITY OF INDICATOR BACTERIA OF FECAL CONTAMINATION,
Wyoming Univ., Laramie. Div. of Microbiology and Veterinary Medicine.
J. C. Adams.
Journal of Environmental Quality, Vol. 14, No. 2, p 261-264, April/June, 1985. 6 Tab, 26 Ref.

Descriptors: *Tar sand, *Coal gasification, *Industrial wastewater, *Indicators, *Bacteria, *Water pollution effects, Coliforms, Streptococci, Wastewater.

The detrimental effects of coal gasification and tar sand process waters on the numbers of indicator bacteria in receiving waters was studied. The objectives were (i) to determine the effect of mixing process waters with 'natural' waters on the numbers of fecal coliforms and fecal streptococci after storage of these mixtures at 4 and 20 C, (ii) to determine if the growth phase at the time of exposure was important to the survival of Escherichia coli, and (iii) to determine the importance of pH in the toxicity of a process water. Addition of 10% (vol/vol) of one coal gasification water to river water resulted in approximately 90% reduction in numbers of fecal coliforms within 5 h of storage at 4 C, whereas there was a 65% reduction during this time when storage was at 20 C. An additional coal gasification water and two tar sand process waters were not toxic to fecal coliforms. Survival of fecal streptococci was not adversely affected in any of the waters. Stationary phase cells of E. coli were killed within 5 h of exposure to a 10% concentration of Hanna IV B-1 coal gasification water, whereas lag and exponential phase cells were unaffected during this exposure time. Further, after 24 h of exposure, 40% of the lag phase cells were viable, while live cells from the other two phases of growth were reduced by 99.9%. There was a 12% reduction in viable cells of E. coli after 120 h of exposure to a 10% concentration of Hanna IV B-1 process water adjusted to pH 7.0. In contrast, during this same time period there was a 5 log reduction in viable cells that were exposed to the process water (pH 8.6), which had not been neutralized. (Author's abstract)
W85-06725

SEDIMENT, SEASON, AND SALINITY EFFECTS ON PHOSPHORUS CONCENTRATIONS IN AN ESTUARY,
Agricultural Research Service, Beltsville, MD.
H. M. Kunishi, and D. E. Glotfelty.
Journal of Environmental Quality, Vol. 14, No. 2, p 292-296, April/June, 1985. 7 Fig, 2 Tab, 14 Ref.

Descriptors: *Sediments, *Seasonal variation, *Salinity, *Phosphorus, *Estuarine environment, *Wye River, *Maryland, *Water pollution effects, Nonpoint pollution sources, Nutrients, Best management practices, Agricultural runoff, Runoff.

A 4-yr study was made to better understand nonpoint-source inputs of P into the Wye River - a shallow, well-mixed estuary of the Chesapeake Bay. Water and sediment samples were taken periodically from along the length of the river and from the main freshwater tributary. Phosphorus forms and concentrations in solution were measured and P sorption isotherms were determined from sediment samples. Molybdate-reactive P concentrations were highest during the summer in the uppermost reaches of the river under tidal influence and decreased with increasing salinity downstream. Molybdate-reactive P concentrations in the river thus appeared to depend on the season and to indicate that increasing temperatures promote P release from sediment and P mineralization by benthic and other marine organisms. In additon, molybdate-reactive P in the river was released from sediment when fresh water from a tributary diluted the divalent cation concentration of the brackish water. Best-management farm practices to reduce the loss of P by runoff would not be

expected to markedly lower the concentration of molybdate-reactive P in the river. (Author's abstract)
W85-06727

AVAILABILITY OF CADMIUM TO PERFUSED RAINBOW TROUT GILLS IN DIFFERENT WATER QUALITIES,
Uppsala Univ. (Sweden). Inst. of Zoophysiology.
P. Part, O. Svanberg, and A. Kiessling.
Water Research, Vol. 19, No. 4, p 4127-434, 1985. 6 Fig, 2 Tab, 37 Ref.

Descriptors: *Cadmium, *Trout, *Water properties, *Toxicity, *Heavy metals, Hardness, Chemical properties, Gills, Alkalinity, Salinity, Acidity, Osmolarity, Metabolism, Metals.

Cadmium uptake in freshwater fish occurs mainly via the gills, the the toxicity of Cd for fish is dependent on the water quality. The uptake of cadmium in perfused gills from rainbow trout was studied in different water qualities. The transfer of Cd and retention of the metal in gill tissue is, at constant hardness, related to the cadmium ion activity in the water. Inorganic Cd complexes appear less available than the free ion. The Cd transfer is strongly dependent on the hardness of the water. Hardness acts by a biological mechanism probably by changing gill permeability for Cd. Cd transfer through the gills and Cd retention in gill tissue appeared to be two separate processes. The Cd content of gill tissue did not necessarily reflect the real availabiliy of Cd to fish in different water qualities. (Baker-IVI)
W85-06729

INFLUENCE OF SURFACTANTS ON GILL PHYSIOLOGY AND CADIUM UPTAKE IN PERFUSED RAINBOW TROUT GILLS,
Uppsala Univ. (Sweden). Inst. of Zoophysiology.
P. Part, O. Svanberg, and E. Bergstrom.
Ecotoxicology and Environmental Safety, Vol. 9, No. 2, p 135-144, March, 1984. 2 Fig, 4 Tab, 32 Ref. National Swedish Environmental Protection Board grant 5340052-9.

Descriptors: *Trout, *Toxicity, *Surfactants, *Cadmium, *Gills, Water pollution effects, Zinc, Water pollution effects, Fish.

Cadmium, in the concentrations tested, had no measurable effect on gill viability during 45 or 60 min of perfusion. The vascular resistance and the oxygen transfer remained stable and did not differ significantly from the control. The Na(+) net flux was positive. The viability of the gills was severely affected in the presence of 100 micromol/liter linear alkylaryl sulfonate (LAS) or nonylphenol ethoxylate (NP-10EO). The vascular resistance increased gradually during the perfusion, followed by a concomitant decrease in oxygen transfer. The net flux of Na(+) over the epithelium was negative. The activity of Cd(2+) was reduced slightly in the presence of 100 micromole/liter LAS or NP-10EO. This indicates that part of the metal was bound by the detergents. There was no difference in the Cd binding between the anionic LAS and the nonionic NP-10EO. No significant impact on gill viability was observed in lower concentrations of metal and surfactant. LAS markedly reduced Cd transfer in the high dose combination of (100 microm/liter LAS + 8.1 micromol/liter Cd). The retention of Cd in perfused tissue was not affected. Unlike LAS, NP-10EO in the high dose mixture did not affect the Cd transfer through the gills. The tissue retention of the metal was doubled in the presence of the nonionic detergent. The mixtures of surfactants and Cd in the high dose experiments had basically the same effects on gill viability as the surfactants alone. The most prominent difference is that the Na(+) net flux was significantly more negative in the mixtures, especially in the presence of Np-10EO. No increase in vascular resistance was noted in the mixture Cd + LAS. (Baker-IVI)
W85-06741

CONTAMINATION AND EFFECTS IN FRESHWATER DITCHES RESULTING FROM AN AERIAL APPLICATION OF CYPERMETHRIN,
Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.
S. W. Shires, and D. Bennett.
Ecotoxicology and Environmental Safety, Vol. 9, No. 2, p 145-158, April, 1985. 5 Fig, 5 Tab, 8 Ref.

Descriptors: *Toxicity, *Water pollution effects, *Cypermethrin, *Insecticides, *Aquatic life, Zooplankton, Invertebrates, Fish, Pesticide residues, Pyrethroid insecticides.

Cypermethrin (Ripcord) was applied at 25 g ai/ha by fixed-wing aircraft to a large field (11.6 ha) of winter wheat bordered on three sides by drainage ditches. About 60% of the nominal application rate was deposited on the crop and about 6% was deposited over the water surface. The amount of spray drift deposited upwind declined sharply with increasing distance from the treated field. Downwind, the spray drift was small but occurred over a much greater distance. Relatively high spray deposits were found along the banks of the ditches adjacent to the crop (200 to 700 micro-g/sq m) and the deposits over the ditches themselves were obviously related to the close proximity of the waterways to the treated field and to the practice of respraying the field headlands. Analyses of subsurface water suggested that any spray drift reaching the ditches resulted in very low or undetectable residues of cypermethrin in the general water body. Any cypermethrin residues that were detected did not persist for significant periods and none were detected in samples taken later than 2 days after application. No serious affects were noted on zooplankton and macroinvertebrate fauna at the different sampling stations. The aerial application of cypermethrin adjacent to freshwater bodies resulted in limited contamination of the water, with consequently only minor short-term effects on a few sensitive forms of aquatic life. (Baker-IVI)
W85-06742

USE OF THE BIVALVE MYTILUS EDULIS AS A TEST ORGANISM FOR BIOCONCENTRATION STUDIES. 1. DESIGNING A CONTINUOUS-FLOW SYSTEM AND ITS APPLICATION TO SOME ORGANOCHLORINE COMPOUNDS,
National Swedish Environment Protection Board, Stockholm. Special Analytical Lab.
L. Renberg, M. Tarkpea, and E. Linden.
Ecotoxicology and Environmental Safety, Vol. 9, No. 2, p 171-178, April, 1985. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Bivalves, *Mytilus, *Bioconcentration, *Organochlorine compounds, Trichlorobiphenyl, Methoxychlor, Pentachlorobenzene, Lindane, Pesticides, Water pollution effects, Bioaccumulation.

Most bioconcentration studies have previously been carried out using fish as a test organism. Equally important is the use of bivalves for this purpose, from both an ecological and an economic point of view. A continuous-flow system has thus been designed for use also with extremely hydrophobic substances and evaluated using 2,4',5-trichlorobiphenyl, methoxychlor, pentachlorobenzene, and lindane. The variation of the uptake in the individuals after 3 weeks' exposure was quite small (relative standard errors varied from 10.1 to 15.3% depending on the test substance), indicating a high degree of reproducibility. The bivalves, however, are known to close their valves under unfavorable conditions, which occasionally may bias the results. To overcome this disadvantage, it is suggested that an internal standard - i.e., a chemically defined compound - be added to the water simultaneously with the test substances. Athough there is a principal risk for interactive effects, unexpected variations in the uptake can thus be compensated for by relating the concentration of the test substance to the concentration of the internal standard in the organisms. Comparisons between continuous-flow systems and static systems have also been made. Continuous-flow systems are more suitable for studying hydrophobic compounds than static systems. (Author's abstract)
W85-06743

COMPARISON OF PHYSIOLOGICAL CHANGES IN CARP, CYPRINUS CARPIO, INDUCED BY SEVERAL POLLUTANTS AT SUBLETHAL CONCENTRATIONS. I. THE DEPENDENCY ON EXPOSURE TIME,
Karlsruhe Univ. (Germany, F.R.). Dept. of Zoology II.
G. Gluth, and W. Hanke.
Ecotoxicology and Environmental Safety, Vol. 9, No. 2, p 179-188, April, 1985. 6 Fig, 26 Ref.

Descriptors: *Animal physiology, *Fish, *Carp, *Water pollution effects, Blood physiology, Toxicity, Aldrin, Pesticides, Atrazine, DDT, Dieldrin, Endrin, Hexachlorbenzene, Lindane, Methanol, Phenols, Toluene.

Carp were exposed to 10 different pollutants at sublethal concentrations for 6, 24, or 72 hr. Blood, liver, and white muscle samples were taken after the exposure time together with samples of control handled fish. Serum concentrations of glucose, cortisol protein, and cholesterol were determined. Similarly, the liver and muscle glycogen contents were measured. The effects of the following pollutants were examined: aldrin (100 micro g/liter), atrazine (100 micro g/liter), DDT (50 micro g/liter), dieldrin (20 micro g/liter), endrin (2 micro g/liter), hexachlorbenzene (100 micro g/liter), lindane (100 micro g/liter), methanol (1 ml/liter), 4-N-phenol (100 micro g/liter), toluene (100 micro l/liter). The rises in serum glucose and cortisol were the most frequent changes occurring after exposure to the pollutants. A decline in plasma protein and cholesterol content was also often observed. Liver glycogen concentration increased first in most cases and was reduced after longer exposure. Muscle glycogen was affected differently, sometimes reduced by exposure to the pollutants. The experimental design allows for the gradual increase in toxicity of the pollutants used regarding the applied concentrations. The test for proof of toxicity of those chemicals was evaluated. The determination of serum glucose and cortisol levels can be proposed as mostly useful. The clearest changes in all parameters were found after treatment with 100 micro g/liter atrazine and 50 micro g/liter DDT. When serum glucose and cortisol concentrations were quickly elevated, signs for exhaustion could be seen after 72 hr of exposure. (Author's abstract)
W85-06744

EFFECTS OF LEAD ON DELTA-AMINOLEVULINIC ACID DEHYDRATASE ACTIVITY, GROWTH, HEMOGLOBIN CONTENT, REPRODUCTION IN DAPHNIA MAGNA,
Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
R. Berglind, G. Dave, and M. L. Sjobeck.
Ecotoxicology and Environmental Safety, Vol. 9, No. 2, p 216-229, April, 1985. 10 Fig, 2 Tab, 39 Ref.

Descriptors: *Lead, *Water pollution effects, *Aminolevulinic acid dehydratase, *Hemoglobin, *Reproduction, *Daphnia, Toxicity, Heavy metals, Crustaceans, Animal physiology, Enzymes.

The effects of continuous exposure to lead for various periods and recovery in clean water on delta-aminolevulinic acid dehydratase (ALA-D) activity, hemoglobin content, growth, and reproduction were studied in Daphnia magna. Steady-state inhibition of ALA-D activity was reached within 2 days in 16, 64, and 256 micro-g Pb/liter, but restoration in clean water was prolonged in relation to previous exposure. Inspite of the inhibition of ALA-D activity hemoglobin content increased after 2 days in 16 and 24 micro-g Pb/liter. Furthermore, hemoglobin content in previously exposed animals increased during recovery in clean water. Maximum hemoglobin content (2.9 times control value) was found after 2 days recovery of animals exposed to 64 micro-g Pb/liter. These findings suggest that some enzyme(s) other than ALA-D in the biosynthetic pathway of hemoglobin formation is (are) more sensitive to lead. Growth, in contrast to reproduction, was stimulated by low concentrations of lead (< 64 micro-g Pb/liter), although in 256 micro-g Pb/liter growth was also significantly impaired. After 19 days the 16 and 50% reproductive impairment concentrations were < or = 1 and 10 micro-g Pb/liter, respectively. (Collier-IVI)

W85-06745

BIOACCUMULATION OF SOME FORESTRY PESTICIDES IN FISH AND AQUATIC PLANTS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
W. L. Lockart, D. A. Metner, B. N. Billeck, G. P. Rawn, and D. C. G. Muir.
ACS Symposium Series, Vol. 238, p 298-315, 1984. 6 Fig, 5 Tab, 27 Ref.

Descriptors: *Pesticides, *Bioaccumulation, *Fish, *Aquatic plants, Organic compounds, Fenitrothion, Aminocarb, Permethrin, Fluorene, Hydrocarbons, Trout, Larvae, Duckweed.

Bioaccumulation of some pesticides (fenitrothion, aminocarb, permethrin) with real or potential application in forestry in Canada has been examined in lab experiments using larval rainbow trout and common duckweed. Since some of the formulations of forest pesticides also contain solvents of petroleum distillates, experiments were also carried out with a hydrocarbon, fluorene, which is a component of fuel oil. Accumulations of fluorene in fish were higher than any of the pesticides. Calculations were made of uptake and depuration rate constants which were used to predict residue accumulations under various exposure conditions. In spite of the limitations on values produced by simple lab experiments as reported here (use of radioactivity to indicate a compound, single exposure concentrations, steady state assumptions, lack of allowance for growth dilution, first order depuration kinetics), the rate constants derived have given a surprisingly good estimate both of some published field biconcentration measurements and of other predictions based on larger amounts of data. (Baker-IVI)
W85-06772

EFFECTS OF HEATING ON GROWTH AND CONDITION OF PIKEPERCH (LUCIOPERCA LUCIOPERCA) IN LOWLAND PONDS CREATED BY SAND EXTRACTION,
Katholieke Univ. Leuven (Belgium). Lab. for Ecology and Fauna Management.
D. Draulans, J. van Vessem, and A. F. De Bont.
Hydrobiologia, Vol. 122, No. 3, p 213-217, March, 1985. 3 Fig, 6 Tab, 7 Ref.

Descriptors: *Thermal pollution, *Pikeperch, *Water pollution effects, Belgium, Growth, Fish, Ponds, Seasonal variation, Artificial ponds, Effluents, Powerplants.

The growth rates and condition of pikeperch (Lucioperca lucioperca) originating from two lowland ponds at Mol (north Belgium) were compared. One pond, the Lagune (65 ha, depth 4-12 m), receives heated effluent from two power plants; the other, Plas Leblanc (10 ha, depth 2-8 m) receives no effluent. Scalimetry and operculometry were used to measure growth. Growth rates were slightly higher in the Lagune, whereas no differences in overall condition of fish from the two ponds were seen. There were neither significant differences between sexes with one pond, nor for one sex between the two ponds. There were, however, strong seasonal differences in condition between the ponds. At the Plas Leblanc, condition increased toward summer, in which it reached a peak of 1.29. For the Lagune, condition was minimal in summer, and increased from then on until spring, when it reached a maximum of 1.23. Summer temperatures in the heated pond probably were above the optimum for pikeperch. (Rochester-IVI)
W85-06788

INFLUENCE OF A METAL-CONTAMINATED TRIBUTARY ON THE INVERTEBRATE DRIFT FAUNA OF THE KING RIVER (TASMANIA, AUSTRALIA),
Tasmania Univ., Hobart (Australia). Dept. of Zoology.
R. Swain, and R. W. G. White.
Hydrobiologia, Vol. 122, No. 3, p 261-266, March, 1985. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Metals, *Water pollution effects, *Invertebrates, *Aquatic drift, *King River, *Tasmania, *Australia, Mayflies, Nymphs, Animal behavior, Behavior.

Drifting invertebrates were collected upstream of, at, and downstream of the input of metal contaminated water into the previously unpolluted King River in western Tasmania. In the upstream section the drift fauna showed characteristics similar to those observed by other workers with a marked nocturnal peak. Changes in drift rates at the site of input were observed and it is hypothesized that mayfly nymphs, and possibly other animals, respond to the change in water quality by leaving the water column and randomly searching the substrate for clean water. Most nymphs re-enter the drift in a current of clean water which was displaced towards the opposing bank by the entry of contaminated water. This re-entry of animals into the drift occurs some four hours after the main nocturnal peak in drift rates. (Author's abstract)
W85-06790

ACCELERATED EUTROPHICATION IN A NEW ZEALAND LAKE: LAKE ROTOITI, CENTRAL NORTH ISLAND,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
For primary bibliographic entry see Field 2H.
W85-06794

EFFECTS OF SODIUM AND POTASSIUM CHLORIDES ON THE GROWTH AND ACCUMULATION OF MINERAL IONS BY CYPERUS INVOLUCRATUS ROTTB,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
R. J. Hocking.
Aquatic Botany, Vol. 21, No. 3, p 201-217, March, 1985. 7 Fig, 5 Tab, 25 Ref.

Descriptors: *Sodium chloride, *Potassium chloride, *Cyperus, *Wastewater treatment, *Plant growth, *Ions, Salts, Salinity, Calcium, Magnesium, Plant physiology.

The response of the large emergent aquatic plant Cyperus involucratus Rottb. to NaCl and KCl salinities was studied under glasshouse conditions. Growth was not affected greatly by 50 mM NaCl or 100 mM KCl, but plants treated with 110 mM NaCl or 200 mM KCl were stunted and showed symptoms of salt toxicity. NaCl salinity was more detrimental than KCl, and Cl was more damaging to plant growth than K, but less damaging than Na. Salinity had no effect on plant succulence. NaCl and KCl treatments caused a decrease in concentration of Ca and Mg in plant tissue, and NaCl-stressed plants accumulated nitrate-N. Na was largely excluded from leaves, whereas K was not. Concentrations up to 4% Cl, 8% K and 2.3% Na (dry wt. basis) were recorded in above-ground plant organs. C. involucratus is potentially a useful plant for inclusion in aquatic plant filters to treat wastewaters, and harvestable parts of the plant (culms and leaves) had over 60% of the total plant K, Na and Cl. The results are discussed with respect to the use of C. involucratus in systems for wastewater reclamation. (Author's abstract)
W85-06803

SUBMERSED MACROPHYTE COMMUNITIES OF ADIRONDACK LAKES (NEW YORK, U.S.A.) OF VARYING DEGREES OF ACIDITY,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W85-06804

EFFECTS OF INSECTICIDES ON THE BENTHIC COMMUNITY IN A MODEL STREAM,
National Inst. for Environmental Studies, Tsukuba (Japan).
M. Yasuno, Y. Sugaya, and T. Iwakuma.
Environmental Pollution (Series A), Vol. 38, No. 1, p 31-43, 1985. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Insecticides, *Benthos, *Water pollution effects, *Streams, Pesticides, Toxicity, Zoobenthos, Algae, Midges, Organophosphorus pesticides, Temephos, Chlorphoxim.

The benthic community in an outdoor model stream was exposed to the organophosphorus insecticide temephos, at a concentration of 5 mg/liter for 30 min, or chlorphoxim at 2 mg/liter for 3 h. Three species of chironomids were predominant in this stream in the first experiment, together with Hydropsychodes brevilineata in the second experiment. Both insecticides killed the majority of the zoobenthos, and resulted in a bloom of epilithic algae. The extent of grazing pressure by chironomids on algae was assessed. The chironomid populations recovered quickly but the trichopteran larvae recovered slowly. There were some differences in the toxicity between the two insecticides. Paracyclops fimbriatus and Procladius sp. were affected only by chlorphoxim. (Author's abstract)
W85-06815

TWENTY-FIVE YEARS OF PHYTOPLANKTON ON THE WEST FORK AND MAIN STEM OF THE WHITE RIVER: 1958-1982,
Indiana State Board of Health, Indianapolis.
For primary bibliographic entry see Field 2H.
W85-06849

EFFECTS OF ENVIRONMENTAL GRADIENTS CONCERNING WATER QUALITIES ON THE STRUCTURE OF THE PHYTOPLANKTON COMMUNITY IN THE COASTAL SEA,
Hiroshima Univ. (Japan). Inst. of Environmental Chemistry.
For primary bibliographic entry see Field 2L.
W85-06853

FIELD AND LABORATORY STUDIES OF ION BALANCE AND GROWTH RATES OF RANID TADPOLES CHRONICALLY EXPOSED TO LOW PH,
Pennsylvania State Univ., University Park. Dept. of Biology.
J. Freda, and W. A. Dunson.
Copeia, No. 2, p 415-423, 1985. 5 Fig, 2 Tab, 28 Ref.

Descriptors: *Ion balance, *Growth rate, *Tadpoles, *Frogs, *Hydrogen ion concentration, Water pollution effects, Animal physiology, Sodium, Chloride, Ponds, Growth stages.

The effect of sublethal, chronic exposure of tadpoles to low environmental pH under natural conditions was investigated by making weekly measurements of various physiological variables. Rana sylvatica tadpoles from a low pH pond (pH 4.05 - 4.90) had lower body sodium, chloride and water concentrations in comparison with tadpoles from a nearby high pH pond (pH 5.74-6.37). Tadpoles from both ponds placed in the low pH pond also underwent higher sodium efflux than when placed in the high pH pond. These observations parallel similar studies on fish and demonstrate the effects of low environmental pH on larval anuran ionic regulatory mechanisms. Survival times of field-collected R. sylvatica tadpoles placed at pH 3.0 (H_2SO_4) did not change with age nor were there any differences between tadpoles from high and low pH ponds. However, survival times of laboratory-raised R. pipiens tadpoles did increase with age, and animals raised at pH 4.4 grew slower than siblings at pH 5.8. (Author's abstract)
W85-06859

PHYTOPLANKTON OF LAKE SIMCOE DURING THE ICE-FREE PERIODS OF 1980-82 AND POTENTIAL RESPONSE TO REDUCED PHOSPHORUS LOADINGS,
Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 2H.
W85-06860

MORTALITY OF ZOOPLANKTON RESULTING FROM TEMPERATURE REGIMENS EN-

COUNTERED IN ONCE-THROUGH COOLING SYSTEMS,
Ontario Hydro, Toronto. Research Div.
J. K. Kwik, and T. G. Dunstall.
Journal of Great Lakes Research, Vol. 11, No. 1, p 26-33, 1985. 6 Fig, 1 Tab, 18 Ref.

Descriptors: *Zooplankton, *Heated water, *Cooling water, *Temperature effects, Thermal stress, Water pollution effects, Water temperature, Rotifers, Diacyclops, Crustaceans.

The crustacean zooplankters Diacyclops bicuspidatus thomasi and Bosmina longirostris and the rotifers Polyarthra spp. and Keratella spp. were subjected to thermal regimens simulating entrainment through condenser cooling water systems of generating stations to determine their thermal tolerance. Animals collected from Lake Ontario at lake water temperatures ranging from 8.0 to 19.5 C were exposed to temperature increases of 5, 10, 15, 20, and 25 C. All four taxa tolerated larger temperature increases as ambient temperature decreased. Predictive models indicated that mortality due to thermal stress would be under 10% for all taxa tested providing lake water temperature after heat addition does not exceed 29 C. Acclimation of the animals did not influence the total temperature tolerated following exposure to lethal temperatures. (Author's abstract)
W85-06862

DISTRIBUTION OF OLIGOCHAETES IN LAKE MICHIGAN AND COMMENTS ON THEIR USE AS INDICES OF POLLUTION,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5A.
W85-06866

NOTE ON EUTROPHIC CHARACTERISTICS OF TWO FRESHWATER BODIES OF KURUKSHETRA, INDIA,
Kurukshetra Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W85-06868

MINERAL CONTENT OF CANADA GOOSE EGGS AND IMPLICATIONS FOR ENVIRONMENTAL SURVEILLANCE ALONG THE COLUMBIA RIVER,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
For primary bibliographic entry see Field 5A.
W85-06873

FACTORS AFFECTING TRACE METAL ACCUMULATION BY ESTUARINE OYSTER CRASSOSTREA VIRGINICA,
District of Columbia Univ., Washington. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W85-06878

ADAPTIVE BEHAVIOR OF EURYHALINE PHYTOPLANKTON COMMUNITIES TO ARSENIC STRESS,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
J. G. Sanders, and S. J. Cibik.
Marine Ecology - Progress Series, Vol. 22, No. 2, p 199-205, March, 1985. 7 Fig, 3 Tab, 24 Ref.

Descriptors: *Water pollution effects, *Arsenic, *Phytoplankton, Productivity, Population dynamics, Biomass, Species composition, Diatoms, Algal growth.

Long-term experiments performed with large column continuous cultures of natural phytoplankon assemblages exposed to low levels of arsenate (1 to 10 x ambient concentration) have shown that arsenate is differentially inhibiting to some phytoplankton species. This observed variance in sensitivity is sufficient to cause a marked change in species composition and succession of dominant species in arsenic-treated assemblages with a potential for impact upon carbon transfer between trophic levels, even though estimates of community biomass and productivity indicate no change. A common response to arsenic dose in this study was replacement of dominant algae by species that were taxonomically similar. Although similar taxonomically, the replacement species varied greatly in size or shape from the original dominant. The replacement of relatively large centric diatoms by smaller species within a phytoplankon community can be of important ecological significance. Diatoms appeared either to be turned off or turned on in arsenic-dosed cultures. Flagellates exhibited a somewhat different response. Flagellates that were affected by arsenate did not exhibit the abrupt declines in population densities seen in affected diatoms. While growth rates of the species were depressed somewhat, the species continued to react to environmental cues such as changing light intensities or nutrient concentrations. (Baker-IVI)
W85-06879

PARTICULATE LOAD OF THE RED RIVER, ST. IVES BAY: ITS GEOCHEMICAL COMPOSITION AND THE EFFECT OF ITS DISCHARGE PLUME ON THE BEHAVIOUR OF A RESIDENT WILD DOLPHIN,
Institute of Oceanographic Sciences, Wormley (England).
R. J. Morris, M. L. McCartney, C. Lockyer, and R. Hoborn.
Marine Pollution Bulletin, Vol. 16, No. 3, p 106-108, March, 1985. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Dolphins, *Water pollution effects, *Particulates, *Metals, *St. Ives Bay, *Red River, *England, Behavior, Water analysis, Antimony, Arsenic, Copper, Zinc, Clay.

A solitary, male bottlenosed dolphin has in recent years become a resident of the area around Godrevy Head and Godrevy Island, England. Field observations indicate that the normal swimming range of this dolphin is influenced by the discharge plume of the Red River which empties into St. Ives Bay. A detailed geochemical analysis was made of the solid material in the river's discharge. The Red River was found to have a high particulate load (30 g/l dry matter) mostly composed of very finely divided material which stays in suspension in seawater for some time. Clays (illite and kaolinite) and quartz were the major components of the river particulates. Organic carbon and carbonates were minor components. In addition to SiO2 and Al2O3, Fe2O3 was the other major component comprising nearly 10% of the particulate matter. A number of other metals were present as significant components including Sn (2000 ppm), As (1000 ppm), Cu (992 ppm), Zn (150 ppm), and Zn (190 ppm). The dolphin's behavior may be brought about due to the presence of a dense cloud of finely divided metal particulate which would impeed the functioning of its delicate sensory system or it may be able to detect the presence of high levels of potentially toxic metals such as Sn, As, Cu, and Zn. (Baker-IVI)
W85-06880

COMPARISON OF AVOIDANCE RESPONSES OF AN ESTUARINE FISH, FUNDULUS HETEROCLITUS, AND CRUSTACEAN, PALAEMONETES PUGIO, TO BIS(TRI-N-BUTYLTIN)OXIDE,
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
A. E. Pinkney, L. W. Hall, M. J. Lenkevich, D. T. Burton, and S. Zeger.
Water, Air and Soil Pollution, Vol. 25, No. 1, p 33-40, May, 1985. 2 Fig, 27 Ref.

Descriptors: *Estuarine environment, *Avoidance response, *Animal behavior, *Fish, *Crustaceans, *Butyltin oxide, Mummichog, Shrimp, Water pollution effects, Antifoulants, Organic tin, Tin.

Avoidance responses of an estuarine fish, mummichog (Fundulus heteroclitus), and a crustacean, grass shrimp (Palaemonetes pugio), to the antifoulant bis(tri-n-butylin)oxide (TBTO) were evaluated. Four out of six groups of mummichogs tested at 1.0 micro g total organic Sn/L showed avoidance. Total organic Sn concentrations > or = 3.7 micro g/L were avoided by this fish species in all cases. Higher concentrations of total organic Sn did not result in greater avoidance responses. Grass shrimp did not avoid total organic Sn concentrations between 2.3 and 30.0 micro g/L. Response data at 2.3 and 30 micro g/L were similar. Mummichogs and grass shrimp differed greatly in their abilities to avoid potentially adverse concentrations of total organic Sn. Since mummichogs are major predators of grass shrimp, these behavioral responses may have important implications for tidal marsh ecosystems. (Author's abstract)
W85-06887

TRACE ELEMENT CONCENTRATIONS IN THE DORSAL MUSCLE OF WHITE SUCKERS AND BROWN BULLHEADS FROM TWO ACIDIC ADIRONDACK LAKES,
Department of Energy, New York. Environmental Measurements Lab.
M. Heit, and C. S. Klusek.
Water, Air and Soil Pollution, Vol. 25, No. 1, p 87-96, May, 1985. 8 Tab, 26 Ref.

Descriptors: *Trace elements, *Fish, *Suckers, *Bullheads, *Acid lakes, *New York, *Trace metals, *Water pollution effects, Lake sediments, Sediments, Silver, Arsenic, Cadmium, Chromium, Copper, Mercury, Nickle, Lead, Antimony, Selenium, Tin, Teliurium, Vanadium, Zinc, Fish physiology.

Concentrations of 14 elements (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, Tl, V, and Zn) were measured in the dorsal muscle of omnivorous white suckers and brown bullheads, fish likely to ingest sediment while feeding. The fish were collected in two acidic Adirondack lakes known to have elevated concentrations of several of these elements in their surface sediment. Trace element concentrations in the muscle of the while suckers and brown bullheads were compared with government guidelines for edible fish and survey data for concentrations present in commercial species. Only the largest white sucker exceeded the U.S. Food and Drug Administrations's guidelines for Hg in food of 1 ppm (wet wt). Concentrations of all the other elements measured were at low or innocuous levels in the edible muscle. A significant positive correlation was found between body weight and Hg concentrations in both species. Zinc was negatively correlated for the same parameters in white suckers. With the possible exception of Hg, elevated levels of potentially toxic elements in the surface sediment of the two acidic Adirondack lakes are not reflected in the edible muscle of the omnivorous bottom feeding fish present in these systems. (Author's abstract)
W85-06889

EFFECT OF SIMULATED ACID RAIN ON MYCORRHIZAL INFECTION OF PINUS STROBUS L.,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
H. F. Stroo, and M. Alexander.
Water, Air and Soil Pollution, Vol. 25, No. 1, p 107-114, May, 1985. 4 Tab, 22 Ref.

Descriptors: *Acid rain, *Water pollution effects, *Mycorrhizae, *Soil fungi, *Root development, *Pine trees, Fungi, Trees, Roots, Hydrogen ion concentration, Sulfates, Nitrates, Seedlings.

Mycorrhizal infection but not growth of white pine seedlings was reduced by application of simulated rain at pH 3.5 at 3 times ambient rates to plants grown in steamed Mardin soil inoculated with Pisolithus tinctorius. In unsteamed Mardin soil, the simulated acid rain at 3 times ambient rates had no effect on mycorrhizal infection or growth of pine seedlings if the rain was applied to the plants and soil or to only the soil before planting, except that nitrate-containing acid rain increased growth, infection and N content. In limed Mardin soil, the simulated acid rain reduced mycorrhizal infection if applied to the plants and soil as the seedlings were growing but not if applied to the soil before planting. Application of pH 3.5 rain at ambient rates had no detectable influence on mycorrhizal infection in 6 of 9 soils tested, but it

stimulated infection in 3 soils if the simulated rain contained only sulfate and in 1 soil if it had both sulfate and nitrate. (Author's abstract)
W85-06890

FIELD EVALUATION OF TWO ENDOTHALL FORMULATIONS FOR MANAGING HYDRILLA IN GATUN LAKE, PANAMA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 4A.
W85-06900

HANDBOOK ON THE BISCAYNE AQUIFER WATER MANAGEMENT, WATER CONSERVATION HEALTH AND COST OF DRINKING WATER.
Environmental Coalition of Broward County, Inc., Fort Lauderdale, FL.
For primary bibliographic entry see Field 6D.
W85-06906

CALCIUM OXIDE AND HYDROXIDE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario). Environmental Protection Programs Directorate.
For primary bibliographic entry see Field 5A.
W85-06935

OPTIMIZING SALINITY CONTROL STRATEGIES FOR THE UPPER COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. G. Evans, W. R. Walker, and G. V. Skogerboe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-136143. EPA-600/2-82-077, November 1982. Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma. 210 p, 37 Fig, 14 Tab, 220 Ref, 4 Append. Contract/Grant No. R-806148.

Descriptors: *Salinity, *Salinity control, *Cost-benefit analysis, *Optimization, Systems analysis, Colorado River.

Salinity is the most serious water quality problem in the Colorado River Basin. The impact, felt largely in the Lower Basin, is acute because the basin is approaching conditions of full development and utilization of all available water resources. Current estimates indicate that each mg/l increase in concentration at Imperial Dam results in $450,000 annual damages. Therefore, in order to offset salinity caused by the development of the vast energy supplies and to allow the seven Colorado River Basin states to fully utilize their allocation of Colorado River water, it is necessary to implement cost-effective salinity control programs in the basin. A simple multi-level nonlinear optimization procedure was utilized to formulate the most cost-effective array of salinity control strategies for the Upper Colorado River Basin. The results qualitatively indicated the anticipated salt load reduction and expected annual costs of each salinity reduction increase for any preselected level control. Costs and salinity contributions associated with various alternatives were generated using January, 1980, estimated conditions. Marginal cost analysis based on current damage estimates indicate that the optimal cost-effective salinity control program in the Upper Basin would cost about $30 million annually and remove about 1.2 million megagrams of salt/yr. Optimal salinity control programs are presented for the individual alternatives, for individual areas or projects, for the states of Colorado and Utah and the Upper Colorado River Basin.
W85-06960

EVALUATION OF WASTEWATER DISINFECTION ALTERNATIVES,
Ontario Ministry of the Environment, Toronto. Wastewater Treatment Section.
For primary bibliographic entry see Field 5D.
W85-06963

ACUTE LETHAL TOXICITY OF PRUDHOE BAY CRUDE OIL AND COREXIT 9527 TO ARCTIC MARINE FISH AND INVERTEBRATES,
LGL Ltd., Toronto (Ontario).
M. G. Foy.
EPS 4-EC-82-3, July 1982. Department of the Environment, Ottowa (Ontario). 62 p, 19 Fig, 14 Tab, 66 Ref.

Descriptors: *Water pollution effects, *Dispersants, *Toxicity, *Marine animals, *Oil, *Crustaceans, *Fish, *Bioassays, Oil pollution, Amphipods, Copepods, Ecological effects, Hydrocarbons, Oily water.

The toxicities of Prudhoe Bay crude oil, the dispersant Corexit 9527 and mixtures of these, to several arctic marine amphipods, one arctic marine copepod and one arctic marine fish were studied in semi-static 96 hr bioassays in which exposure concentrations were measured by fluorescence spectroscopy. In general, sensitivities of all species were remarkably similar for any one toxicant. The 96 hr LC50 values ranged from 28 to 66 mg/L for sodium lauryl sulfate (a reference toxicant), from 104 to 175 mg/L for Corexit, from 45 to 196 microfilters/L for Prudhoe Bay crude oil dispersed with Corexit 9527, and from 32 to 73 microliters/L for Prudhoe Bay crude oil dispersed mechanically. Mortality in oil-Corexit-water mixtures was much higher than in oil-water mixtures of the same nominal oil concentration. This was thought to be due to the higher concentrations of oil in the water column to which the organisms were exposed when the disperant was used. Based on measured hydrocarbon concentrations in the water column, the toxicity of the oil-Corexit-water mixtures was less than that found for the oil-water mixtures. This was attributed to the smaller ratio of dissolved hydrocarbons to total measured hydrocarbons in the oil-Corexit-water mixtures, than that in the oil-water mixtures.
W85-06970

SUBLETHAL EFFECTS OF DISPERSED OIL ON AN ESTUARINE ISOPOD,
Environmental Sciences Ltd., Vancouver (British Columbia).
W. S. Duval, L. A. Harwood, and R. P. Fink.
Report EPS 4-EC-82-1, June 1982. Environmental Protection Service, Ottawa, Ontario. 72 p, 12 Fig, 7 Tab, 44 Ref, 1 Append.

Descriptors: *Dispersants, *Oil spills, *Chemical analysis, *Sublethal effects, *Estuarine isopods, Oil slicks, Estuaries, Toxicity, Physiological ecology, Oil, Isopods.

The sublethal effects of physically and chemically (Corexit 9527) dispersed Prudhoe Bay crude oil on the physiology and behavior of the estuarine isopod, Gnorimosphaeroma oregonensis were examined in a minicomputer controlled flow-through system. Test organisms received oil concentrations approximating 0, 3 and 20% of the calculated 48 hr LC50 for periods of 24 and 48 hours for each dispersion type. The effects of exposure concentration, exposure duration and dispersed oil type on both critical and subcritical sublethal parameters were investigated, as well as the rate and extent of recovery responses. In general, exposure to both physically and chemically dispersed oil caused a significant increase in oxygen consumption of treated isopods and a concomitant decrease in carbon assimilation rates and efficiencies. In addition, isopods exposed to oil dispersions accumulated naphthalenes in their tissues, and in some cases showed altered moulting patterns and mating responses. The magnitude and persistence of sublethal effects were usually dependent upon oil concentration and exposure duration. In most cases, exposure to chemically dispersed oil resulted in more pronounced sublethal effects than comparable treatments with physically dispersed oil. These sublethal effects, however, usually persisted < 48 hr beyond the end of the oil exposure. The significance of the sublethal effects and subsequent recovery responses observed in the test populations are discussed.
W85-06971

FIELD SURVEY OF HEAVY METAL UPTAKE BY NATURALLY OCCURRING SALTWATER AND FRESHWATER MARSH PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W85-06976

STREAM WATER QUALITY IN THE COAL REGION OF TENNESSEE,
Northeastern Forest Experiment Station, Berea, KY.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-122713. General Technical Report NE-77, 1982. 125 p, 40 Fig, 72 Tab, 8 Ref.

Descriptors: *Water quality, *Water pollution effects, *Baseline studies, *Hydrologic data collections, *On-site data collections, *Coal mining, *Small watersheds, *Ecological effects, Data collections, Trace elements, Discharge frequency, Suspended solids, Alkalinity, Acidity, Hydrogen ion concentration, Coal mine wastes, Coal mines, Nitrogen, Phosphorus, Turbidity, Specific conductivity.

Water quality data for 69 small streams sampled in 15 counties of Tennessee where coal is surface-mined was compiled to establish a data base for small first-order unmined and surface-mined watersheds throughout Appalachia. Criteria for stream selection in unmined watersheds stated that these watersheds were to be strictly unmined. The newly mined watersheds had to have no mining before January 1972, and the old mined watersheds had to have no mining or reclamation since January 1972. Most of the streams were sampled at approximately monthly intervals from June 1977 through August 1979 for the common ions, alkalinity, acidity, pH, 16 trace elements, 5 nitrogen and phosphorus species, specific conductance, suspended solids, turbidity, settleable matter, water temperature, and estimated discharge. The water quality data collected in this study of small reference watersheds should provide a basis for future studies and should be especially helpful in determining the probable hydrologic consequences of future mining operations.
W85-06980

METHODOLOGY FOR OVERLAND AND IN-STREAM MIGRATION AND RISK ASSESSMENT OF PESTICIDES,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W85-06989

EFFECT OF ACIDIFICATION DAMAGES ON THE ECONOMIC VALUE OF THE ADIRONDACK FISHERY TO NEW YORK ANGLERS,
Clarkson Univ., Potsdam, NY. Dept. of Economics.
J. K. Mullen, and F. C. Menz.
American Journal of Agricultural Economics, Vol. 67, No. 1, p 112-119, February, 1985. 2 Tab, 33 Ref.

Descriptors: *Fisheries, *Acid rain, *Acid precipitation, *Economic factors, *Adirondack Mountains, *New York, Model studies, Water pollution effects, Recreation, Sport fishing, Travel costs.

A travel cost model is used to estimate losses in the net economic value of the Adirondack recreational fishery resulting from damages caused by acidic deposition. The model used cross sectional data to estimate angling demand and economic value of the fishery. Acidification damages were assumed to cause the loss of certain ponded water angling sites, leading to changes in site use and reducing the fishery's value to anglers. While this approach has important limitations, the results represent an initial attempt to quantify one type of cost associated with acidic deposition. The relationship between angling demand and habitat availability was determined with data from a 1976 survey of licensed New York resident anglers. Annual losses to the anglers are estimated to be approximately $1 million per year in 1976 dollars. (Baker-IVI)

W85-07034

VARIATIONS IN MELOSIRA ISLANDICA VALVE MORPHOLOGY IN LAKE ONTARIO SEDIMENTS RELATED TO EUTROPHICATION AND SILICA DEPLETION,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W85-07072

NOTE ON ANTIBIOTIC RESISTANCE IN THE BACTERIAL FLORA OF RAW SEWAGE AND SEWAGE-POLLUTED RIVER TIGRIS IN MOSUL, IRAQ,
Mosul Univ. (Iraq). Dept. of Biology.
M. M. Al-Jebouri.
Journal of Applied Bacteriology, Vol. 58, No. 4, p 401-405, April, 1985. 3 Tab, 26 Ref.

Descriptors: *Antibiotic resistance, *Bacteria, *Wastewater pollution, *River Tigris, *Iraq, *Mosul, Coliforms, Escherichia, Pseudomonas, Staphylococcus, Serratia, Micrococcus, Klebsiella, Streptococcus, Bacillus.

Polluted water samples collected from the River Tigris in the vicinity of a raw sewage outfall were examined for the incidence of antibiotic resistance among coliform bacteria on three occasions during 1983. Eighty percent or more of the coliform bacteria were resistant to one or more antibiotics. At the same time, raw sewage samples were examined for the incidence of antibiotic-resistant bacteria, and Escherichia coli, Pseudomonas spp. and Staphylococcus spp. were selected for sensitivity testing. Collectively, more than 90% of the 480 strains of the three organisms were resistant to one or more antibiotics. The minimal inhibitory concentration (MIC) of ampicillin for twenty-nine strains including coliforms, E. coli, Klebsiella sp., Serratia sp., Pseudomonas aeruginosa, Pseudomonas sp., Micrococcus sp., Staphylococcus aureus, Streptococcus faecalis and Bacillus sp. from raw sewage and polluted River Tigris water was determined and that for P. aeruginosa was 250 micro-g/ml. The high incidence of antibiotic-resistant bacteria in natural waters could be related to the widespread use of antibiotics in this locality. (Author's abstract)
W85-07087

HEAVY METALS IN FUCUS VESICULOSUS IN THE HUMBER ESTUARY,
Anglian Water Authority, Lincoln (England). Lincoln Div.
B. E. Barnett, and C. R. Ashcroft.
Environmental Pollution (Series B), Vol. 9, No. 3, p 193-213, 1985. 6 Fig, 6 Tab, 41 Ref.

Descriptors: *Humber Estuary, *England, *Heavy metals, *Fucus, Algae, Cadmium, Chromium, Copper, Iron, Manganese, Nickel, Lead, Zinc, Estuaries, Suspended sediments, Particulate matter, Path of pollutants.

Samples of brown seaweed Fucus vesiculosus from the south bank of the Humber Estuary (England) have been analyzed for Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn. Distribution of Cd, Cu, Ni and Zn along the estuary are represented graphically. Cd and Ni are conservative, but the plots for Cu and Zn suggest inputs of these metals in the lower estuary. Elevated Fe levels are considered to result from contamination by suspended sediment, but concentrations at one site in the lower estuary are indicative of an input of soluble iron. All Pb and Cr results can be accounted for entirely by particulate contamination. Data from the Humber is compared with figures available in the literature. Concentrations of Cd, Cu and Zn are much greater than 'background' levels and compare with contaminated conditions elsewhere, while Ni concentrations include the highest values reported for any location. It is concluded that Fucus vesiculosus in the Humber exhibits substantially elevated levels of heavy metals. (Author's abstract)
W85-07105

MEASUREMENT OF THE EFFECT OF AROCLOR 1254 ON THE RESPIRATION OF GAMMARUS USING POTENTIOMETRIC RESPIROMETRY,
New York Univ. Medical Center, NY. Inst. of Environmental Medicine.
J. M. O'Connor, J. H. Samuelian, K. J. Salamon, and J. C. Pizza.
Water Research, Vol. 19, No. 5, p 639-643, 1985. 1 Tab, 22 Ref. National Inst. of Environmental Health Sciences grant ES0026.

Descriptors: *Polychlorinated biphenyls, *Toxicity, *Amphipods, *Respirometry, *Potentiometry, Aquatic animals, Gammarus, Crustaceans, Aroclor 1254, Respiration.

Exposure of aquatic organisms to contaminants at sublethal concentrations should result in a rapid response directed either toward compensation for the stress imposed, or toward repair of the damage caused by the contaminant. Such responses require an expenditure of energy, which would be reflected in a change in oxygen consumption. The effect of exposure to the polychlorinated biphenyl (PCB) Aroclor 1254 on the respiration rate of single Gammarus was determined using potentiometric respirometry. Respiration rate decreased in all samples after PCB exposure, with a mean reduction of 0.0364 micro-mol oxygen/hr. Similar statistical conclusions are obtained when metabolic rates are compared. The simplicity of the potentiometric method relative to manometric studies justifies selection of the potentiometric technique over differential manometric methods. Since individual organisms could be tested, even subtle changes in respiration associated with a contaminant-related stress were detectable without the complication of population variance. (Baker-IVI)
W85-07122

EFFECTS OF SUBACUTE CADMIUM EXPOSURE ON A HARDWATER MOUNTAIN STREAM MICROCOSM,
Utah Water Research Lab., Logan.
D. A. Selby, J. M. Ihnat, and J. J. Messer.
Water Research, Vol. 19, No. 5, p 645-655, 1985. 3 Fig, 7 Tab, 22 Ref.

Descriptors: *Cadmium, *Water pollution effects, *Microcosms, *Streams, Toxicity, Invertebrates, Periphyton, Bioaccumulation, Water pollution effects, Food chain, Aquatic plants.

Open stream microcosms in the RIFFLE (Research Installation for Fate and Effects in Lotic Environments) facility were exposed to 22 micro-g/l cadmium for 21 days. This exposure resulted in accumulation of less than 0.3% of the metal passing through the system. Most of the cadmium accumulated in the Aufwuchs communities growing on cobble in the riffles or on macrophytes in the pools probably in response to photosynthetically induced CdCO3 precipitation. The cadmium appears to have been transferred, in part, up the food chain through grazers and collectors, apparently by ingestion of CdCO3-frosted periphyton and detritus, but adsorption to external surfaces also appears to be significant, and differential absorption through gill surfaces of the various species cannot be ruled out. Predators showed little tendency to concentrate cadmium. Community structure studies were somewhat surprising in light of the cadmium accumulation data. Collector-gatherers exhibited significantly greater increases in the pools in the microcosms treated with cadmium relative to the controls, and predators increased significantly in the riffles of treated systems. There was no apparent effect on periphyton community structure or on grazers, despite the relatively high Cd accumulation in these trophic groups. This experiment demonstrates both strengths and weaknesses of the open microcosm approach. (Baker-IVI)
W85-07123

EFFECT OF FECAL POLLUTION ON VIBRIO PARAHAEMOLYTICUS DENSITIES IN AN ESTUARINE ENVIRONMENT,
Rhode Island Univ., Kingston. Dept. of Microbiology.
W. D. Watkins, and V. J. Cabelli.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1307-1313, May, 1985. 7 Fig, 3 Tab, 29 Ref.

Descriptors: *Water pollution effects, *Narragansett Bay, *Rhode island, *Vibrio, *Zooplankton, *Bacteria, Estuaries, Public health, Bays, Human pathogens, Wastewater pollution, Particulate matter.

Field and laboratory studies were conducted to determine whether Vibrio parahaemolyticus responds to nutrient loading, specifically that from municipal sewage treatment plant effluents. Results of field studies categorically show an association of V. parahaemolyticus densities with fecal pollution in the Narragansett Bay estuary and suggest an association with the particulate matter in the water. The greater correlation of V. parahaemolyticus densities with net zooplankton rather than with phytoplankton levels in the bay is consistent with the findings of other investigators and suggests a more direct role of the zooplankters. In laboratory studies, growth of V. parahaemolyticus was noted only when zooplankters or chitin was added. Neither the decay nor the increase in V. parahaemolyticus densities in the lab investigations was affected by the addition of sewage. The effect of sewage on V. parahaemolyticus densities in Narragansett Bay is an indirect one, commencing with nutrient loading, probably mediated through the food chain and manifested at the zooplankton level. The higher densities of V. parahaemolyticus found in the near surface waters throughout the upper bay suggests a relationship to light. Nutrients in wastewater effluents resulting in biostimulation of phytoplankton may indirectly increase the zooplankton levels and, hence, V. parahaemolyticus densities. (Baker-IVI)
W85-07132

EFFECTS OF ENVIRONMENTAL FACTORS ON TOXICITY OF A CYANOBACTERIUM (MICROCYSTIS AERUGINOSA) UNDER CULTURE CONDITIONS,
Tokyo Metropolitan Research Lab. of Public Health (Japan).
M. F. Watanabe, and S. Oishi.
Applied and Environmental Microbiology, Vol. 49, No. 5, p 1342-1344, May, 1985. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Light intensity, *Temperature effects, *Nutrients, *Cyanophyta, Microcystis, Toxicity, Bacteria, Phosphorus, Toxins.

Blooms of the toxic blue-green algae Microcystis aeruginosa are commonly observed in highly eutrophic lakes. Effects of light intensity, temperature, and nutrients on the toxicity of M. aeruginosa were investigated, using a toxic strain which kills mice. Throughout the study a marked change in toxicity was observed in the light intensity experiments. Production of the toxin was suppressed under low light intensity. Similar LD50 values were estimated for cells grown under 30.1 and 75.3 micro-E/sq m/s. This means that light intensity is the primary important factor for the production of the toxin, but high toxin production can occur at relatively low light intensity. Only slight changes were noted to be due to temperature changes and phosphorus deficiency. (Baker-IVI)
W85-07134

IMPACT OF NITROGEN AND PHOSPHORUS ON (14C)-LIGNOCELLULOSE DECOMPOSITION BY STREAM WOOD MICROFLORA,
Oregon State Univ., Corvallis. Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W85-07136

TRACE-METALS AND CHLORINATED HYDROCARBONS IN BIRDS' EGGS FROM THE DELTA OF THE DANUBE,
Dipartimento di Biologia Ambientale, Univ. de Siena, Italy.
For primary bibliographic entry see Field 5B.
W85-07146

ACCUMULATION OF LEAD IN FISH FROM MISSOURI STREAMS IMPACTED BY LEAD MINING,

Missouri Dept. of Conservation, Columbia.
J. M. Czarnezki.

Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 736-745, May, 1985. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Lead, *Water pollution effects, *Mine wastes, *Missouri, *Big River, Streams, Rivers, Mining operations, Fish, Public health, Heavy metals, Suckers, Bass, Sunfish.

The possibility of elevated levels of lead ocurring in the edible tissue of fish inhabiting Missouri streams affected by lead mining was investigated. Fish collected from Big River, located in the Old lead Belt, contained the highest concentrations of lead found in fish during this study. Concentrations of lead in 83% of the black redhorse, 96% of the golden redhorse, and 74% of the northern hog suckers collected from sites 3 to 8 (3 miles to 75 miles below a ruptured dam) exceeded the WHO limits of 0.3 ppm for safe consumption. Lead levels in longear sunfish followed a similar pattern to the suckers, but were in general lower overall. Smallmouth bass contained lower concentrations of lead than both suckers and longear sunfish. There was no apparent relationship between lead concentration in smallmouth bass and distance downstream from the mining area. Current mining operations in the New Lead Belt are adversely affecting Missouri streams, but not to the extent that streams are being degraded in the abandoned mining areas in the Old Lead Belt. Big River sediments contain high concentrations of lead, (1,400-2,200 ppm) as does the organic detritus (800-7,000 ppm). Bottom feeding fish like the sucker are continually ingesting lead contaminated sediment and detritus while feeding in Big River. Based on these findings it was recommended that suckers caught in the 40-mile section of Big River downstream from the ruptured Desloge tailings pond dam not be consumed. (Baker-IVI)
W85-07151

SWIMMING PERFORMANCE OF CHANNEL CATFISH (ICTALURUS PUNCTATUS) AFTER NITRITE EXPOSURE,

North Texas State Univ., Denton. Dept. of Biological Sciences.
D. E. Watenpaugh, and T. L. Beitlinger.

Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 754-760, May, 1985. 1 Fig, 1 Tab, 25 Ref.

Descriptors: *Water pollution effects, *Nitrites, *Catfish, *Fish behavior, Toxicity, Swimming, Fish, Behavior modification, Methemoglobin.

The effects of nitrite exposure on the prolonged swimming performance of channel catfish was investigated and the extent that methemoglobinemia resulting from nitrite exposure correlates with performance was also considered. A reduction in prolonged swimming performance was noted in channel catfish exposure to nitrite. This was probably due in part to methemoglobin formation. Methemoglobin in blood reduces delivery of oxygen to tissues by making hemoglobin unavailable for oxygen transport and by shifting the oxygen dissociation curve to the left. Such a shift increases the affinity of hemoglobin for oxygen, thereby making it less able to unload oxygen to the tissues. Channel catfish with larger percentages of their hemoglobin oxidized to methemoglobin by nitrite must rely more heavily on anaerobic glycolysis than aerobic metabolism to fuel locomotor activity. Reduced aerobic metabolism of channel catfish with methemoglobinemia should limit prolonged swimming performance. (Baker-IVI)
W85-07153

LONG-TERM EFFECTS OF 1,2,4-TRICHLOROBENZENE ON FRESHWATER PLANKTON IN AN OUTDOOR-MODEL-ECOSYSTEM,

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
J. P. Lay, W. Schauerte, A. Muller, and F. Korte.

Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 761-769, May, 1985. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Water pollution effects, *Trichlorobenzene, *Plankton, Industrial wastes, Organic compounds, Benzenes, Chlorinated hydrocarbons,.

The effects of 1,2,4-trichlorobenzene (TCB) on a natural freshwater plankton community were measured in a natural pond, rich in Daphnia and phytoplankton species. The pond was divided into discrete compartments by the use of 50 cm diameter tubes, pressed into the sediment. The chemical was highly toxic to the daphnids population present causing a significant reduction. The mean number of daphnids counted in the treated tubes during the post-application period was 10% of the controls. A regeneration phase seemed to begin on day 21, when the TCB-concentration in the water was 50-100 micro-g per liter. The low oxygen concentration did not affect the population dynamics. As to the physico-chemical behavior of the test chemicals, a lower water solubility and a marked reduced volatility from water phase was noted in the field experiments compared with laboratory testing. There was always a significantly higher sensitivity of the daphnids to the pollutants as compared with the EC-50 laboratory values. The effective toxic concentrations were lower to a factor of a hundred as compared with literature. These findings should be considered in the context of predicting the hazards of chemicals from screening tests to the real environment. (Baker-IVI)
W85-07154

AVOIDANCE OF SUSPENDED SEDIMENTS BY SMELT AS DETERMINED BY A NEW 'SINGLE FISH' BEHAVIORAL BIOASSAY,

Department of Fisheries and Oceans, St. Andrews (New Brunswick). Fisheries Research Branch.
D. J. Wildish, and J. Power.

Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 770-774, May, 1985. 3 Tab, 4 Ref.

Descriptors: *Water pollution effects, *Smelt, *Fish behavior, *Suspended solids, *Bioassay, Dredging, Sedimentation, Bottom sediments, Fish, Estuarine environment.

The possibility that smelt are capable of avoiding suspended sediments and hence may avoid fixed nets in the estuary where high levels of suspended sediment are present as a result of dredging and dumping has been investigated. The experiments did provide indirect evidence that smelt could avoid areas high in suspended solids. Because of the apparatus-specific nature of the results and the multiplicity of environmental and innate behavioral factors operating in field conditions, extrapolation from laboratory results directly to the field is problematical. An apparent threshold of about 20 mg suspended sediment/liter for the smelt avoidance response to occur was determined. This is higher than that found for herring (about 10 mg/l) in differently structured tests. These results indicate the need for field studies of smelt behavior where other behavioral drives such as migration and escape movements may overide the avoidance movements observed in these laboratory tests. (Baker-IVI)
W85-07155

TOXICITY OF ENDRIN AND MALATHION MIXTURES TO FLAGFISH (JORDANELLA FLORIDAE),

Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
R. O. Hermanutz, J. G. Eaton, and L. H. Mueller.

Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 307-314, May, 1985. 1 Fig, 7 Tab, 12 Ref.

Descriptors: *Endrin, *Malathion, *Toxicity, *Flagfish, Fish, Pesticide toxicity, Mortality, Interactions, Reproduction, Organophosphate pesticides, Chlorinated hydrocarbons.

Individual endrin and malathion concentrations and mixtures of the concentrations were tested concurrently with flagfish in both chronic and acute exposures. The joint action of mixtures on mortality in chronic exposures consisted of enhanced effects at the higher concentrations not causing death when the pesticides were tested individually. Chronic effects of mixtures on growth followed a simple additive effects model. Malathion did not alter the endrin effects on egg production, and in a separate test it did not affect the uptake or elimination of endrin. Joint action on mortality in acute exposures occurred at 48 and 72 hr but not at 10 and 24 hr. (Author's abstract)
W85-07156

SHORT-TERM INTERACTIONS BETWEEN DDT AND ENDRIN ACCUMULATION AND ELIMINATION IN MOSQUITOFISH (GAMBUSIA AFFINIS),

Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
M. S. Denison, J. E. Chambers, and J. D. Yarbrough.

Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 315-320, May, 1985. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *DDT, *Endrin, *Mosquitofish, *Interactions, *Bioaccumulation, Toxicity, Pesticide toxicity, Insecticides, DDE, Aldrin, Dieldrin.

Experiments were conducted to determine whether interactions in disposition between two insecticides might occur within the first few hours of exposure. Levels of both (C-14)endrin and (H-3)DDT were monitored in serum, gall bladders, and whole bodies during pre- and post-exposures to each compound or analogs, as well as during concurrent exposures in mosquitofish (Gambusia affinis). Prior exposure to DDT for four hr generally reduce endrin accumulation in serum, gall bladders and whole bodies, whereas prior exposure to endrin exerted little effect on DDT accumulation. Simultaneous exposure to DDT and endrin reduced DDT accumulation in the gall bladder at all times and in the whole body during the first two hr; endrin accumulation was generally reduced in the gall bladder and whole body. Endrin levels in fish exposed subsequently to only DDT or DDE were significantly higher in the gall bladder at all times after 0.5 hr and were reduced in the whole body at all times tested, compared to fish exposed subsequently only to uncontaminated water. While endrin post-treatment had no effect on DDT levels in the gall bladder, aldrin and dieldrin exposure resulted in significantly higher gall bladder levels of DDT compared to fish exposed subsequently only to uncontaminated water. The insecticide interactions observed may be the result of competition for and/or displacement of insecticides from mutual binding sites. (Author's abstract)
W85-07157

EFFECTS OF DIESEL OIL AND OIL DISPERSANTS ON GROWTH, PHOTOSYNTHESIS, AND RESPIRATION OF CHLORELLA SALINA,

Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
K.-Y. Chan, and S. Y. Chiu.

Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 325-331, May, 1985. 4 Tab, 37 Ref.

Descriptors: *Oil pollution, *Dispersants, *Water pollution effects, *Chlorella, *Photosynthesis, *Algal growth, Biomass, Chlorophyll a, Estuarine environment, Algal respiration, Phytotoxicity, Oil spills.

Low concentrations of BP light diesel (0.05%) and the oil dispersant BP1100X (0.005%), either alone or in mixture, stimulated the growth rate, biomass yield, chlorophyll a level and photosynthesis of the estuarine green alga Chlorella salina CU-1, while the same concentrations slightly inhibited algal respiration. The increase in the level of chlorophyll a may be one of the factors leading to elevated photosynthesis. BP light diesel and BP1100X at higher concentrations, as well as the oil dispersants BP1100WD and Shell Oil Herder at all the tested concentrations, reduced growth, chlorophyll a

level, photosynthesis, and respiration of the algal cells. The inhibitory action of BP light diesel and the oil dispersants was concentration-dependent. Although both algal photosynthesis and respiration were reduced by BP light diesel and the oil dispersants, the effect on respiration was less severe when compared with that on photosynthesis. Shell Oil Herder, either alone or in combination with BP light diesel, were most toxic among the three oil dispersants tested. In general, mixtures of BP light diesel and any one of three oil dispersants were more toxic than the diesel oil or the oil dispersants alone. However, the stimulatory effect exerted by the mixture of 0.05% BP light diesel and 0.005% BP1100X was greater than those by the same concentrations of BP light diesel and BP1100X alone. (Author's abstract)
W85-07158

EFFECTS OF HEAVY METAL CONTAMINATION OF THE AQUATIC BIOTA OF BUTTLE LAKE AND THE CAMPBELL RIVER DRAINAGE (CANADA),
Victoria Univ. (British Columbia). Dept. of Biochemistry and Microbiology.
M. Roch, R. N. Nordin, A. Austin, C. J. P. McKean, and J. Deniseger.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 3, p 347-362, May, 1985. 7 Fig, 5 Tab, 51 Ref.

Descriptors: *Heavy metals, *Aquatic life, *Water pollution effects, *Buttle Lake, *Campbell River, *British Columbia, Zinc, Copper, Species diversity, Phytoplankton, Periphyton, Crustaceans, Zooplankton, Trout, Toxicity, Mining.

Concentrations of zinc and copper in a series of large oligotrophic lakes on Vancouver Island, Canada, have been increasing since mining operations began near the south end of Buttle lake in 1966. Declines in species diversity of both phytoplankton and periphyton have occurred since the beginning of mining activity with the disappearance of metal sensitive forms such as Asterionella and Rhizosolenia. Cladoceran and calanoid copepod numbers and species diversity increase as the metal concentrations decline downstream from the mine. Bioassays carried out with Daphnia pulex show increasing toxicity downstream. Metal concentrations in zooplankton and metallothionein concentrations in rainbow trout liver are correlated to metal concentrations in the water. The water was not acutely toxic to rainbow trout in laboratory simulations of Buttle Lake conditions or during in situ exposures (1 month). Specific sublethal deleterious effects have not been determined. (Author's abstract)
W85-07160

NATIONAL CONTAMINANT BIOMONITORING PROGRAM: CONCENTRATIONS OF SEVEN ELEMENTS IN FRESHWATER FISH, 1978-1981,
Fish and Wildlife Service, Columbia, MO.
For primary bibliographic entry see Field 5B.
W85-07161

5D. Waste Treatment Processes

USE OF OZONATION IN TREATMENT OF SEWAGE,
Ecole Nationale Superieure de Chimie de Rennes (France). Lab. de Chimie des Nuisances et Genie de l'Environnement.
M. Elmghari-Tabib, H. Benmoussa, A. Laplanche, G. Martin, and B. Langlais.
Ozone: Science and Engineering, Vol. 6, No. 3, p 197-206, 1984. 9 Fig, 8 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Chemical reactions, Ozone, Activated sludge proces, Sludge, Oxygen consumption, Flocculation.

Injection of ozone released during disinfection, or from any other source in activated sludge tanks, at the rate of about 0.2 to 1 mg O3/g SS/hr, considerably improves the settling properties of the sludge, thereby confirming the flocculating effect of ozone. At the present time, it is not possible to conclude about the effect of residual ozone injection on the purification efficiency. Such a process could be considered to remove the need to release or destroy residual ozone resulting from disinfection of sewage. These investigations tie in with current research into forms of ozone action on microorganims. (Baker-IVI)
W85-06213

BIOLOGICAL TREATABILITY OF M-AMINOPHENOL PLANT WASTEWATER CONTAINING STRUCTURAL ISOMERS OF BENZENE WITH DIFFERENT SUBSTITUENTS,
National Environmental Engineering Research Inst., Nagpur (India).
S. D. Deshpande, T. Chakrabarti, P. V. R. Subrahmanyam, and B. B. Sundaresan.
Water Research, Vol. 19, No. 3, p 293-298, 1985. 3 Fig, 5 Tab, 15 Ref.

Descriptors: *Aminophenol, *Wastewater treatment, *Industrial wastewater, Resorcinol, Nitrobenzene sulfonate, Metanilic acid, Activated sludge process, Biodegradation.

Bench scale studies on treatability of combined wastewater from an m-aminophenol (m-AP) manufacturing plant using acclimated activated sludge and an organic loading of 0.12 kg BOD/kg MLVSS/day resulted in removal of around 96% BOD and 59% TOC. Analysis of raw and treated wastewaters by HPLC revealed that resorcinol and m-AP present in the wastewater were completely removed, while m-nitrobenzene sulfonate (m-NBS) removal was only partial. However, in a batch system, preferential utilization of m-NBS was observed when a mixture of m-NBS and resorcinol was fed to m-NBS acclimated activated sludge. Electrolytic respirometric studies showed that oxygen uptake rate of m-NBS acclimated activated sludge with m-NBS as the substrate was not affected in the presence of resorcinol. Also m-AP and metanilic acid (m-AA) had no effect on either resorcinol or m-NBS removal by respective acclimated activated sludges. The incomplete removal of m-NBS from combined wastewater may probably be attributed to the metabolic interaction between m-NBS and an unidentified compound which appeared in the HPLC chromatograms of the raw and treated wastewaters. (Author's abstract)
W85-06220

ASPECTS OF THE DETERMINATION OF COMPLEXATION PARAMETERS FOR METAL-PARTICULATE COMPLEXES IN ACTIVATED SLUDGE,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
R. M. Sterritt, and J. N. Lester.
Water Research, Vol. 19, No. 3, p 315-321, 1985. 6 Fig, 2 Tab, 34 Ref.

Descriptors: *Activated sludge, *Complexation, *Copper, *Lead, *Particulates, Metals, Conditional stability, Ion selective electrodes.

The conditional stability constants and complexation capacities for complexation of copper and lead by activated sludge solids have been determined by titration. The methods used were direct determination of free metal ion using ion selective electrodes and separation of the solids by membrane filtration prior to determination of the free metal in the filtrate. The complexation parameters thus obtained were compared and the importance of several factors, including residual metal concentrations in the sample prior to titration, interferences and the disturbances of complex equilibria during sample manipulation were examined and their potential effects on the calculated values of the complexation parameters were considered. (Author's abstract)
W85-06223

MATHEMATICAL ANALYSIS OF OXYGEN AND NITRATE CONSUMPTION IN DEEP MICROBIAL FILMS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W85-06227

ENVIRONMENTAL INTERVENTION ANALYSIS: WISCONSIN'S BAN ON PHOSPHATE DETERGENTS,
Technical Univ. of Denmark, Lyngby. Inst. of Mathematical Statistics and Operations Research.
L. Pallesen, P. M. Berthouex, and K. Booman.
Water Research, Vol. 19, No. 3, p 353-362, 1985. 6 Fig, 1 Tab, 12 Ref, 3 Append.

Descriptors: *Intervention analysis, *Detergents, *Phosphates, *Wisconsin, Wastewater treatment, Waste load, Time series.

Intervention analysis is a method of assessing the effect of a deliberate change to a system when the data record is a time series. A statistical analysis that assumes fixed mean levels before and after the intervention often is inappropriate for environmental time series, because typically environmental systems display some random drift in level over time, unrelated to the intervention itself. A reliable estimate of the effect of the intervention must take into account such drift. The method presented does this by using suitably weighted averages of observations before and after the intervention; also it can allow for a gap in time over which the intervention gradually realizes its full effect. The method has been used to estimate the decrease in total phosphorus load on the two large wastewater treatment plants in Milwaukee, WI, caused by the ban on phosphate laundry detergents that went into force on July 1, 1979. The estimated effect was equivalent to 0.506 kg P per capita per year. The result of this ban being lifted in 1982 was also estimated; the increase in total P loading was equivalent to 0.187 kg P per capita per year. (Author's abstract)
W85-06228

OXYGEN UPTAKE RATES FOR DETERMINING MICROBIAL ACTIVITY AND APPLICATION,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang, M. D. Cheng, and J. T. Mueller.
Water Research, Vol. 19, No. 3, p 373-381, 1985. 9 Fig, 4 Tab, 17 Ref. EPA grant R808201.

Descriptors: *Activated sludge process, *Oxygen uptake, *Microorganisms, Wastewater treatment, Solids retention time, Viability, Respiratory activity.

The method presented involves using the oxygen uptake rates of activated sludges for determining the microbial activity and viability. The microbial activity correlates well with substrate reduction first order rate constant, K1, determined in batch operations, and with the specific substrate utilization rate, q, of steady state operations. The microbial viability determined based on respiratory activity would result in slightly higher values than other means such as plate counting, since some of the respiratory activity is contributed by nonviable yet active cells. The extent of respiratory activity attributed to the nonviable cells increases as the biological solids retention time increases (or net growth rate decreases). Since the loss of ability of multiplication is not necessarily associated with loss of biochemical activity, the viability determined by the respiratory activity would represent more realistically the activity of microbes and thus is suggested as the preferred technique. (Author's abstract)
W85-06230

INDUSTRIAL WASTEWATER ANALYSIS BY LIQUID CHROMATOGRAPHY WITH PRECOLUMN TECHNOLOGY AND DIODE-ARRAY DETECTION,
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W85-06257

BIOLOGICAL-CHEMICAL METHOD FOR EXAMINATION OF THE INHIBITION OF DECOMPOSITION AND ELIMINATION OF WASTEWATER ORGANIC MATTER (BIOLOGISCH-CHEMISCHES VERFAHREN ZUR PRUFUNG DES ABBAU- UND ELIMINIERUNGSVERHALTENS ORGANISCHER ABWASSERINHALTSSTOFFE),
Forschungszentrum fuer Wassertechnik, Dresden (German D.R.).
V. Peukert.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 319-327, 1983. 3 Fig, 9 Ref.

Descriptors: *Wastewater treatment, *Decomposition, *Activated sludge process, Inhibition, Organic matter, Biomass, Substrate.

After checking for toxic inhibition of degradation, degradation behavior at concentrations below the toxicological threshold value should be tested. For this, activated sludge with 1.5-2 g/l organic dry weight in special reaction vessels with stirring and aeration equipment as well as electrochemical oxygen measurement is used. The adaptation is effected by a repeated change of the aqueous phase with the test substance as the single carbon source. Measurements are carried out in three vessels: control, experimental vessel and another experimental vessel of the makeup of volume at sampling. The increase of biomass and the consumption of substrate are determined from samples. Determination of totals as COD and/or organic carbon is recommended, since the determination of the pure substrate only allows analysis of the persistence, but not the full degradation. The technique, represented with the schematic diagram and examples of application, can be automated easily. (Author's abstract)
W85-06262

POSSIBILITY OF TREATMENT OF WASTEWATER FROM ARTIFICIAL LEATHER PRODUCTION WITH THE HELP OF ALGAE (MOGLICHKEITEN DER NACHREINIGUNG VON ABWASSERN AUS DER KUNSTLEDERPRODUKTION MIT HILFE VON ALGEN),
Vysoke Uceni Technicke, Gottwaldov (Czechoslovakia). Technologicka Fakulta.
J. Chromek, J. Kupec, P. Marvan, and M. Mladek.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 329-338, 1983. 4 Fig, 21 Ref.

Descriptors: *Artificial leather industry, *Biological wastewater treatment, *Algae, Wastewater treatment, Dimethylformamide, Dimethylamine, Decomposition, Aeration, Carbon dioxide, Ammonia, Combined treatment, Municipal wastewater.

In the production of a special artificial leather (BAREX) in Czechoslovakia, wastewaters containing dimethylformamide (DMF) and dimethylamine (DMA) are produced. Investigations have shown that cultures of algae (Scenedesmus quadricauda) are able to use the two substances as a nitrogen nutrient source after a period of adaptation. During the course of decomposition reactions, the pH-value plays an important part, since at increased values ammonia is released, which has a temporarily inhibitory effect on the production of algae masses and daughter cells. This detrimental effect can be considerably reduced by aeration with air containing carbon dioxide (3%). Since the production of algal biomass is restricted by a phosphorus deficiency, a combined treatment with municipal sewage is very advantageous, according to the results from investigations. (Author's abstract)
W85-06263

PLANNING EFFECTIVE INDUSTRIAL LIQUID WASTE CONTROLS IN DEVELOPING NATIONS,
Democritus Nuclear Research Center, Athens (Greece).
For primary bibliographic entry see Field 6A.
W85-06287

ULTRASOUND CATALYZED OZONE PRETREATMENT TO REDUCE ORGANIC FOULING OF REVERSE OSMOSIS MEMBRANES,
Arizona Univ., Tucson. Dept. of Civil Engineering.
R. A. Sierka.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-161453/AS, Price codes: A07 in paper copy, A01 in microfiche. Project Completion Report OWRT/RU-82/3, Sept 1982. 125 p, 34 Fig, 43 Tab, 52 Ref, Project No. OWRT C-00067-R (1), Contract/Grant No. 14-34-0001-0456.

Descriptors: *Pretreatment of water, *Reverse osmosis, *Ozone, *Membrane fouling, Humic acids, Ultrasonics, Arizona.

An evaluation was made of an ozone-ultrasound pretreatment process to reduce fouling tendencies of reverse osmosis membranes by organics (humic, fulvic acid), organics interacting with inorganic colloids (silicon dioxide) and biological matter (secondary treated and clarified domestic wastewater). The untreated and treated samples were characterized by various physical and chemical parameters such as pH, temperature, turbidity, and total organic carbon, while the reduction in fouling potential was evaluated with the use of a newly developed mini-plugging factor test.
W85-06299

FEASIBILITY OF USING FOREST VEGETATION TO RENOVATE SEPTIC TANK EFFLUENT IN THE NEW JERSEY PINE BARRENS,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
J. G. Ehrenfeld.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157634/AS, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, May 1984. 83 p, 10 Fig, 39 Tab, 22 Ref, Project No. OWRT B-082-NJ (1), Contract/Grant No. 14-34-0001-1245.

Descriptors: *Nutrient removal, *Nitrogen, *Phosphorus, *Plant growth, Water pollution prevention, Transpiration, Septic tanks, Pervious soils, Root distribution, Groundwater pollution, *New Jersey Pine Barrens, Pine forest.

A study was undertaken of nutrient and water use by upland woody plants of the New Jersey Pine Barrens in order to determine if these plants can prevent groundwater contamination by septic tank leachate. Matched sets of plots of oak-pine and pine-scrub oak forest were situated over septic tank leach fields and in undisturbed forest. Total above-ground biomass (50-60 Mt) was most strongly affected by the disturbance history of the stand; stand biomass in turn was the most important factor determining nutrient uptake in net primary production (44-73 kg N/ha/yr, and 3-10 kg P/ha/yr), and nutrient storage in perennial woody tissues (50-93 kg N/ha and 5-10 kg P/ha). Although some species showed increased tissue nutrient concentrations on septic tank plots, there was insufficient increase in uptake over the control plots to account for the nutrient input in leachate. Similarly, xylem water potential and leaf diffusion in the six major tree and shrub species showed only sporadic evidence of increased water use on septic tank plots. Studies of root distribution and soil moisture with depth also suggested that septic tank leachate in not available to the 83% of the roots located in the top 30 cm of soil. The results do not support the use of vegetation to renovate septic tank leachate in these soils, and it is suggested that nutrient uptake be removed from groundwater quality models used in regulating housing development in the region.
W85-06310

ADSORPTION OF ANIONIC AND CATIONIC METALS BY NON-IONIC POLYMERIC RESINS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
A. J. Rubin, and W. F. Wargo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157659/AS, Price codes: A05 in paper copy, A01 in microfiche. Ohio Water Resources Center, Columbus, August 1984. 78 p, 14 Fig, 5 Tab, 65 Ref, Append, Project No. OWRT B-076-OHIO (1), Contract/Grant No. 14-34-0001-9090.

Descriptors: *Anion adsorption, *Cation adsorption, Cadmium, Chromium, Zinc, Polymeric resins, Wastewater treatment, Tertiary treatment, Metals, Adsorption.

Experiments were conducted to determine the effect of pH on the adsorption of cadmium and zinc cations and anionic chromate ion on six synthetic polymer resin absorbents. In general, the removal of Zn(II) and Cd(II) increased with increasing pH while the adsorption of chromate ion increased with decreasing pH. Of the six resins examined, Amberlite XAD-7 was the most effective for cations while Ambersorb XE-348 was the most effective for the metal anion. The adsorption of chromate was significantly more sensitive to the adsorbate concentration than the adsorbent dose. Adsorption maxima shifted to a lower pH as the resin dose was decreased. Chromate adsorption was best described by an equation in the form of the BET isotherm. Both the Langmuir and Freundlich equations were successful in fitting the cation adsorption data. Comparison of the Langmuir parameters obtained for the adsorption of Zn(II) and Cd(II) by Amberlite XAD-7 with those of other adsorption systems suggests that the nonionic polymeric resins are relatively ineffective adsorbents for simple unhydrolyzed cations. Further study is required with chromate ion although the results suggest that its adsorption by carbonaceous resins may be economically feasible.
W85-06312

REVIEW OF THE MUNICIPAL POLLUTION ABATEMENT PROGRAMS IN THE GREAT LAKES BASIN.
International Joint Commission-United States and Canada, Windsor (Ontario). Municipal Abatement Programs Task Force.
For primary bibliographic entry see Field 5B.
W85-06330

EVALUATION OF WASTES FROM THE EAST ST. LOUIS WATER TREATMENT PLANT AND THEIR IMPACT ON THE MISSISSIPPI RIVER,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5C.
W85-06343

SULPHURIC ACID AND OLEUM, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
Envirotips manuals, February 1984. 132 p, 30 Fig, 11 Tab, 192 Ref.

Descriptors: *Water pollution control, *Sulfuric Acid, *Aquatic Life, Environmental quality, Pollutants, Oleum, Spills, Chemical spills, Cleanup, Sludge, Contaminants, Food chains, Acidity, Bioaccumulation.

Technical and environmental information concerning handling and preventing problems spills from sulphuric acid and oleum are presented. Sulfuric acid is a colorless, odorless oily liquid. Its synonyms include: battery acid, fertilizer acid, oil of vitriol, hydrogen sulfate, sulfuric acid spent, and acide sulphurique. It is neither flammable nor combustible. Hydrogen gas may be formed on contact with metal. It is harmful to aquatic life in some species, in concentrations as low as 6 mg/l primarily due to its acidity. There is no potential for bioaccumulation or food chain concentration. For spill control, access to the spill site needs to be restricted. A warning of corrosive should be issued and authorities and the manufacturer need to be notified. It is important to keep the contaminated water from entering sewers or watercourses. For emergency control procedures in water, contain with spill with weirs, damming with gravel, earth, or by diversion. Then, the sulfur can be neutralized and the sludge removed. Oleum is colorless, oily liquid with a choking odor. Its synonyms are fuming sulfuric acid, disulfuric acid, dithionic acid,

and pyrosulfuric acid. It is neither flammable nor combustible. Hydrogen gas formed by reaction of the acid with metal may accumulate inside tanks regardless of strength. Oleum is very reactive with many substances and reacts violently on contact with water. It is harmful to aquatic life in some species, in concentrations as low as 6 mg/l, primarily due to its acidity. There is no potential for bioaccumulation or food chain concentration. A spill requires a corrosive warning and countermeasures are the same as for sulfuric acid.
W85-06355

SULPHUR, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
Envirotips manuals, March 1984. 69 p, 9 Fig, 5 Tab, 163 Ref.

Descriptors: *Water pollution control, *Sulfur, *Aquatic Life, Environmental quality, Pollutants, Problem spills cleanup, Hazardous materials, Toxicity, Contaminants, Dredging.

Technical and environmental information for the management of problem spills of sulfur are presented. Sulfur as a solid is yellow powder, slates, granules, lumps, or prills. As molten, it is yellow to orange-red/brown liquid (temperature dependent). Its synonyms include Bensulfoid, Colloidal-S, Colsul, Crystex, Brimstone, Flowers of Sulfur, and Sulphur. Sulfur is combustible. It produces toxic sulphur dioxide gas during combustion. The dusty may explode if there is an ignition source. It may react violently in contact with oxidizing agents or powdered metals. Fire hazard is increased if hydrogen sulfide is present. Sulfur may be harmful to aquatic life in high concentrations as a suspended solid. Elemental sulfur may pose a serious hazard in high concentrations especially in colloidal form. Covering of the bottoms of water bodies may also cause problems. Molten sulfur will solidify, sink to the bottom and similarly pose a threat to bottom life. There is no potential for accumulation or food chain concentration. Elemental sulfur will undergo slow oxidation in water, generating acidic conditions (probably a mixture of sulfurous and sulfuric acids). Immediate action for spill control includes: issuance of warning 'combustible' and notifying both the fire department and the supplier. Emergency control procedures in water include the containment of discharge by damming or water diversion and the removal of the solidified material and precipitate from the bottom, with suction hoses or mechanical dredges.
W85-06356

BENZENE, ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.
Environmental Protection Service, Ottawa (Ontario).
Envirotips manuals, March 1984. 107 p, 26 Fig, 8 Tab, 210 Ref.

Descriptors: *Water pollution control, *Benzenes, *Aquatic life, Environmental quality, Pollutants, Problem spills cleanup, Hazardous materials, Toxicity, Skimming, Contamination, Bioaccumulation, Sewers, Weirs.

Environmental and technical information for handling and prevention of problem spills of benzene are presented. Benzene is a colorless liquid with a gasoline-like odor. Its synonyms include Benzole, Benzol, Phene, Benzin, Benzine, Benzolene, Bicarburet of Hydrogen, Carbon Oil, Coal Naphtha, Cyclohexatriene, Mineral Naphtha, Motor Benzol, Nitration Benzene, Phenyl Hydride, and Pyrobenzol. Benzene is a flammable liquid. Its vapor forms explosive mixtures with air. Flashback may occur along the vapor trail. Benzene is toxic to aquatic life. It is harmful to some species at concentrations as low as 5 mg/l. Benzene may be bioaccumulative in living organisms, but has no food chain concentration potential. There is a cycling of benzene between the atmosphere and water. For spill control, access to the spill site has to be restricted. Warnings of 'flammable' should be issued. The fire department needs to be called and the manufacturer notified. Sources of ignition have to be eliminated including traffic and equipment. Contact with the liquid spill and its vapors have to be avoided and the contaminated water has to be kept from entering sewers or watercourses. Emergency control procedures in water include containment with booms, weirs or natural barriers. Skimming equipment or suction hoses can be used to remove slick, followed by the application of sorbents. The equipment needs to be explosion-proof.
W85-06357

ULTRAVIOLET DISINFECTION FOR MUNICIPAL WASTEWATER,
Tennessee Eastman Co., Kingsport.
B. F. Severin, and M. T. Suidan.
Chemical Engineering Progress, Vol. 81, No. 4, p 37-44, April, 1985. 8 Fig, 2 Tab, 74 Ref.

Descriptors: *Disinfection, *Drinking water, *Ultraviolet light, Wastewater treatment, Pilot plants, Economic aspects, Maintenance, Effluents.

Recent research efforts in the area of ultraviolet (UV) disinfection for municipal wastewater address fundamental problems such as rapid and complex inactivation kinetics, estimation of light intensity in UV reactors, light absorption and dispersion by the wastewater menstruum, physical and biological protection of the microorganisms, effects of temperature, and effects of mixing on disinfection efficiency. Advances in each of these areas are briefly considered. The future of UV light as a disinfectant for wastewater effluents appears good. Increased knowledge of the design criteria is needed for the full growth capacity of the industry to be realized. Several discouraging notes have also appeared which discuss the unexpected number of shutdowns, leaks, and high maintenance costs incurred in pilot systems for the disinfection of drinking water. (Baker-IVI)
W85-06430

PURIFICATION AND TERTIARY TREATMENT OF AMINE-CONTAINING SEWAGE BY MEANS OF AQUATIC PLANTS (OCHISTKA I DOOCHISTKA AMINOSODERZHASHCHIKH STOCHNYKH VOD C POMOSHCHYU VODNYKH RASTENII),
N. F. Kashina.
Gidrobiologischeski Zhurnal, Vol. 20, No. 3, p 96-100, 1984. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Tertiary treatment, *Amines, *Biological wastewater treatment, *Aquatic plants, Macrophytes, Benzidine, Enzymes, Biomass, Oxidation, Charophyta, Elodea, Aromatic compounds.

Hydrophytes promote a more intensive decrease of xenobiotic concentration than autooxidation. The basic part of eliminated benzidine is subjected to oxidative transformations under effect of enzymatic macrophyte systems. It is found that hydrophyte utilization rate of xenobiotics depends on the plant biomass and abiogenic factors. Half-production tests confirm an expediency of Charophyta and Elodea biofilter application for purification and tertiary treatment of sewage containing aromatic amines. (Author's abstract)
W85-06477

DESIGN OF SMALL TO MEDIUM SIZE COOLING SYSTEMS,
Carter Industrial Products Ltd., Croydon (England).
E. J. Pring.
Chemical Engineer, Vol. 412, p 23-25 and 27, March, 1985. 4 Fig, 2 Tab.

Descriptors: *Cooling towers, *Design criteria, Water reuse, Water supply, Cooling water, Water treatment, Site selection.

Cooling towers nowadays are available in all sorts of shapes, sizes and materials. From a heat transfer point of view they may be either counterflow or crossflow. The design approach is sometimes to choose the minimum size of heat exchanger and select a tower from quotations obtained from various manufacturers. The problems of selection, type and siting are comparatively simple if one takes them logically without external influence and realize the importance of a correct choice. The cooling tower is the end of the chain. It must be able to reject the right amount of heat at the water temperature required to achieve satisfactory process operations. The available site often determines the type of tower. For any given re-cooled temperature from a cooling tower, the selection of the design air wet bulb temperature has a considerable effect on tower size. Factors affecting choice of design air wet blub temperature are considered. Noise, drift loss, plume formation, cooling tower packing, recycled cooling systems, cooling system contamination, water treatment and filtration, maintenance, and comparative costs are also considered. (Baker-IVI)
W85-06556

ENGINEERING-ECONOMIC SIMULATION MODEL FOR REGIONAL WASTEWATER TREATMENT COST FUNCTIONS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
C. M. Macal.
Journal of Environmental Management, Vol. 19, No. 2, p 107-118, September, 1984. 5 Fig, 13 Ref.

Descriptors: *Wastewater treatment, *Costs, *Simulation, Economic aspects, Municipal wastewater, Planning, Water management, Cost analysis, Model studies, Wastewater treatment facilities.

A methodology is described for developing wastewater treatment cost functions that combines concepts from economic theory with engineering relations. The regional cost functions are developed by combining representative cost functions for the individual processes that make up treatment systems at existing plants. The methodology consists of a model of wastewater treatment technology and a cost simulation procedure. A model of the treatment plant operator's decision problem regarding technology modification is an intergral part of the cost simulation procedure. The method was applied to the Dupage River Basin. The costs of two alternative treatment plant location schemes were studied. One was a regionalized plan consisting of a few consolidated plants and the other, a non-regional plan in which all existing treatment plants would continue to operate indefinitely. Treatment plant operations were simulated to the year 2000 for both configurations. Another use of the methodology was to estimate the incremental cost of treating an additional pollutant, total phosphorus, when the technology was already in place for treating BOD5 and suspended solids to levels of 10 mg/l and 12 mg/l, respectively. (Baker-IVI)
W85-06602

EFFECT OF SOIL DEPTH ON WASTEWATER RENOVATION,
City Coll., New York. Dept. of Civil Engineering.
R. M. Khanbilvardi, and D. A. Long.
Journal of Environmental Health, Vol. 47, No. 4, p 184-188, January/February, 1985. 12 Fig, 2 Tab, 10 Ref.

Descriptors: *Wastewater renovation, *Soil depth, *Percolation, *Limestone, Hardness, Soil properties, Chemical oxygen demand, Ammonia, Nitrogen, Nitrates, Acidity, Alkalinity.

A soil column study was conducted to gather information concerning the renovation of percolated wastewater at various depths of limestone soil. The major concern was the effect of such disposal practices on the groundwater quality. In order to determine this effect, information on the variation in the quality of wastewater during percolation through limestone soil columns was obtained from a laboratory study. In the field, the hydraulic and geological properties of the drainage system are important factors in the percolation process and, hence, the results of this lab study only are indications of what might be expected in the field. Deep soil did not affect the pH and alkalinity of the percolated wastewater significantly. The calcium and magnesium hardness increased with increasing limestone soil depth. Reduction of COD in the limestone based soil generally is independent of soil depth. The same conclusions were reached for

the removal of organic nitrogen, nitrite and nitrate nitrogen. The amount of ammonia nitrogen observed in the applied wastewater and percolated effluent from the six-foot (1.83 m) soil column indicated that no removal of ammonia nitrogen occurred in the six-foot depth of limestone soil although some transformation of the ammonia nitrogen did occur. (Baker-IVI)
W85-06609

SWINE LAGOON EFFLUENT APPLIED TO 'COASTAL' BERMUDAGRASS: II. EFFECTS ON SOIL,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
L. D. King, P. W. Westerman, G. A. Cummings, M. R. Overcash, and J. C. Burns.
Journal of Environmental Quality, Vol. 14, No. 1, p 14-21, January/March, 1985. 11 Fig, 2 Tab, 22 Ref.

Descriptors: *Wastewater irrigation, *Soil chemistry, *Grasses, Wastewater disposal, Effluents, Wastewater lagoons, Animal wastes, Nitrates, Phosphorus, Calcium, Magnesium, Nutrients, Groundwater pollution, Sodium, Potassium, Ammonia.

Effluent from animal waste lagoons can degrade water quality if allowed to discharge into surface waters. To determine the feasibility of using swine (Sus scrofa domesticus) lagoon effluent as a source of water and nutrients for crop production, effluent was applied via sprinkler irrigation to Coastal bermudagrass (Cynodon dactylon (L.) Pers.) on Norfolk and Wagram soils (Paleudults) at rates to supply 335, 670, and 1340 kg N/ha/yr for 6 yr. Soil nitrate concentrations to a depth of 300 cm showed significant differences in the order high > medium = low rate. At the high rate, 56% of the applied N could not be accounted for by crop removal or increased N content of the soil to a depth of 210 cm. Evidence of P movement to a depth of 60 cm was obtained. Calcium and Mg concentrations in the topsoil were reduced due to relatively high rates of application of Na(+), K(+), and NH4(+). Soil pH was correspondingly reduced. Soil nitrate data suggest that groundwater pollution by nitrate would result from the high rate and possibly from the medium rate. (Author's abstract)
W85-06612

SWINE LAGOON EFFLUENT APPLIED TO 'COASTAL' BERMUDAGRASS: III. IRRIGATION AND RAINFALL RUNOFF,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
P. W. Westerman, M. R. Overcash, R. O. Evans, L. D. King, and J. C. Burns.
Journal of Environmental Quality, Vol 14, No. 1, p 22-25, January/March, 1985. 4 Tab, 26 Rf.

Descriptors: *Wastewater irrigation, *Runoff, *Grasses, Wastewater disposal, Water pollution sources, Animal wastes, Wastewater lagoons, Effluents, Nitrogen, Phosphorus, Chloride, Infiltration, Nutrients.

In moisture excess regions, irrigation of lagoon effluent to land is generally required to prevent water pollution from lagoon overflow. However, the land area receiving lagoon effluent then becomes a potential nonpoint source of pollution, especially if effluent is applied at high rates. The quantity and quality of rainfall runoff were determined for 6 yr from plots of 'Coastal' bermudagrass (Cynodon dactylon (L.) Pers.) on typical Coastal Plains soils that received weekly irrigations of swine (Sus scrofa domesticus) lagoon effluent during the growing season. Three application rates supplied an average of 335, 670, and 1340 kg N/ha/yr; 90, 180, and 360 kg P/ha/yr; and 200, 400, and 800 kg Cl/ha/yr. The soil-crop characteristics promoted high infiltration of rainfall and the plots were not irrigated during the nongrowing season, when runoff is usually highest. Thus, both runoff volume and nutrient mass transport were low, but nutrient concentrations were relatively high compared with typical concentrations in cropland runoff. Average annual arithmetic mean concentrations ranged from 7 to 13 mg/L for total N and from 3 to 6 mg/L for total P in the three treatments. Treatment differences were usually significant for the high-rate treatment, but not significant between the low- and medium-rate treatments. For this soil-crop system, NO3(-)-N movement to groundwater and P accumulation in the soil for the high- and medium-rate treatments would likely be of more concern than the pollution of rainfall runoff. (Author's abstract)
W85-06613

EFFECT OF FEEDLOT RUNOFF ON A SOUTHERN ILLINOIS FORESTED WATERSHED,
Illinois Univ. at Urbana-Champaign. Dept. of Forestry.
R. H. Pinkowski, G. I. Rolfe, and L. E. Arnold.
Journal of Environmental Quality, Vol. 14, No. 1, p 47-54, January/March, 1985. 3 Fig, 5 Tab, 43 Ref.

Descriptors: *Feedlot runoff, *Forested watersheds, *Land disposal, *Illinois, Wastewater treatment, Nutrient removal, Drainage water, Water pollution sources, Potassium, Phosphorus, Nitrogen, Calcium, Magnesium, Soil properties, Species composition, Animal wastes.

Beef (Bos taurus) feedlot runoff was applied to an oak-hickory (Quercus-Carya) forested watershed to evaluate the effectiveness of the forest in removing and utilizing the added nutrients. Application followed the normal precipitation pattern and was, thus, variable in intensity throughout the year. Feedlot effluent additions averaged 261.1 cu m/ha over the 4-yr study period. High percentages of total nutrient additions were retained by the watershed, but drainage water quality declined over the study period. An average of 99.8% of the added K, 99.4% of the PO4(-3)-P, 99.2% of the Na, and 98.4% of the Ca and Mg were retained by the watershed. Nitrate-N was the only nutrient showing a net loss, averaging 276% of the added NO3(-)-N. In the watershed runoff, NO3(-)-N increased form a baseline mean of 0.83 mg/L to a treatment mean of 12.27 mg/L. Phosphate-P also increased from a baseline mean of 0.02 mg/L to a treatment mean of 0.88 mg/L. Soil physical and chemical properties also changed as a result of the feedlot runoff input. Soil exchangeable cations and anions in the top 7.5 cm increased and bulk density decreased from 1.15 mg/cu M to 1.03 mg/cu M. Maximum soil changes occurred within 30 m of the effluent discharge point. Both tree and herbaceous plant species composition of the watershed also changed during the study period. Plant species composition became more similar to moist-site communities and plant numbers decreased overall. Species characteristic of dry sites decreased in growth rate, while moist site species increased in growth. Results of the experiment indicate that (i) a gravity flow system is an efficient and economical means of dispersing feedlot runoff through a forested watershed, (ii) feedlot effluent can be utilized as a nutrient supplement, and (iii) the vegetation of the oak-hickory forest was an effective biological filter. (Author's abstrct)
W85-06617

EFFECTS OF ANAEROBICALLY DIGESTED POULTRY MANURE ON SOIL PHOSPHORUS ADSORPTION AND EXTRACTABILITY,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. A. Field, R. B. Reneau, Jr., and W. Kroontje.
Journal of Environmental Quality, Vol. 14, No. 1, p 105-107, January/March, 1985. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Manure, *Land disposal, *Phosphorus, *Soil chemistry, Adsorption, Anaerobic digestion, Animal wastes, Effluents, Fertilizers, Langmuir equation.

Research in the past has indicated that large additions of animal manures to soil can reduce soil P adsorption and increase P extractability. However, application rates used in many studies are unrealistic with respect to crop fertilization and land disposal due to the excessive quantities of N applied with the manures. The objective of this study was to evaluate effluent from a poultry manure anaerobic digester applied to a Hayesville loam soil (clayey, oxic, mesic, Typic Hapludult) on soil P adsorption and extractability after three incubation periods (0, 30, and 90 d). Effluent solids were applied at rates corresponding to 753 through 7530 mg N/kg soil. Langmuir equation parameters (from least square fitted data; R sq > 0.98) were used as a basis to compare the influence of treatments on P adsorption properties of the soil. The P adsorption maxima parameter was not influenced by any of the effluent treatments. The parameter related to P bonding energy of the soil was reduced 33 and 41%, respectively, by mid and high rate effluent applications. A similar reduction was not observed for the low rate treatment, which corresponded to fertilizer application of 100 mg N/kg soil. Extractable soil P increased in a predictable manner with increased effluent solids application for all three incubation periods. These increases in extractable P could be described by linear regression equations. The slopes of these lines indicated that a l-g addition of effluent solids to 1-kg soil accounts for increases in extractable P of 3 to 6 mg/kg. (Author's abstract)
W85-06622

IRRIGATION OF FORAGES WITH RENDERING PLANT WASTEWATER: FORAGE YIELD AND NITROGEN DYNAMICS,
Department of Agriculture, Lethbridge (Alberta). Research Station.
J. B. Bole, and W. D. Gould.
Journal of Environmental Quality, Vol. 14, No. 1, p 119-126, January/March, 1985. 11 Tab, 25 Ref.

Descriptors: *Wastewater irrigation, *Rendering plant wastewater, *Crop yield, *Nitrogen, *Forage, Nutrients, Phosphorus, Carbon, Grasses, Alfalfa, Fertilizers, Denitrification.

Wastewater from an animal by-product rendering plant containing N, P, and biochemical oxygen demand (BOD) at greater than 500, 60, and 500 mg/L, respectively, was applied to irrigated forages to study the suitability of forage species and the fate of applied nutrients. Applications of 10 and 20 cm/yr supplied the nutrients at rates in excess of crop requirements. The treatments were compared with irrigation water and with water supplemented with either fertilizer N and P or C as sugar at rates similar to those in the wastewater. Reed canarygrass (Phalaris arundinacea L.) yields were doubled by the application of 10 cm/yr of wastewater as compared with irrigation water treatments, but alfalfa (Medicago sativa L.) yields were not significantly affected. Doubling the wastewater application rate or adding comparable rates of N and P fertilizer did not further increase yields. The wastewater-irrigated alfalfa contained NO3(-)-N levels of 1500 to 1600 mg/kg plant material, while reed canarygrass contained about 3000 to 3400. Both these levels would be considered potentially unsafe for livestock feed. There was an accumulation of soil NO3(-)-N levels of up to 30 to 40 mg/kg soil throughout the surface 120 cm of soil after 5 yr of irrigation with 10 cm/yr of wastewater and two to three times this level with 20 cm/yr of wastewater. Higher levels of NO3(-)-N were observed in the soil when N was applied as fertilizer. Soil NH4(+)-N levels were not greatly affected. A nitrogen balance over 6 yr at the high application rate suggested plant uptake, soil NO3(-)-N, and losses accounted for 30, 25, and 45% of wastewater N and 29, 39, and 32% of fertilizer N. A 1-yr N-15 balance after 3 yr of irrigation indicated uptake, soil NO3(-)-N, and unaccounted-for N was about 10, 19, and 71% for wastewater and 15, 33, and 52% for fertilizer N. The greater losses of wastewater N compared with fertilizer N were attributed to enhanced denitrification due to oxidizable C in the wastewater. Attempts to simulate this effect with C as sugar were not effective. (Author's abstract)
W85-06623

OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS THROUGH MINIMIZING THE VOLUME OF ACTIVATED SLUDGE AND FINAL CLARIFICATION TANKS (OPTIMIER-

UNG DES BELEBUNGSVERFAHRENS DURCH MINIMIERUNG DES VOLUMENS VON BELEBUNGS- UND NACHKLARBECKEN),
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
F. Tucke, J. Kaeding, and H.-J. Walther.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 125-136, 1983. 7 Fig, 9 Ref.

Descriptors: *Activated sludge process, *Optimization, *Tanks, Settling, Sludge thickening, Aeration tanks, Clarification, Wastewater treatment.

Volumes of aeration tanks and final clarification tanks can be minimized through a separate examination of the processes of settling and thickening of activated sludge. Initial quantities are given of wastewater quantity, inflow and outflow concentrations of BOD5, wastewater temperature and reflux ratio of activated sludge. Three parameters of the thickening behavior of activated sludge as well as a parameter for the bioactivity of sludge, which are to be determined in an experimental plant, are provided. The optimum concentration of the activated sludge in the aeration tank is calculated from these givens. At the optimum concentration the total of volumes for aeration tank and final clarification tank becomes a minimum. The process is carried out numerically through use of an example. (Baker-IVI)
W85-06656

COLOUR REMOVAL FROM TEXTILE EFFLUENTS USING HARDWOOD SAWDUST AS AN ABSORBENT,
Minya Univ. (Egypt). Dept. of Chemical Engineering.
H. M. Asfour, M. M. Nassar, O. A. Fadali, and M. S. El-Geundi.
Journal of Chemical and Biotechnology, Vol. 35 A, No. 1, p 28-35, January, 1985. 11 Fig, 19 Ref.

Descriptors: *Color removal, *Textile mill wastes, *Wastewater treatment, *Sawdust, Dyes, Adsorbents, Temperature, Activation energy, Wood, Particle size.

Textile mills engaged in the finishing of cotton goods discharge highly colored wastewater. Biological treatment processes, which are generally efficient for biochemical oxygen demand and suspended solids removal, are largely ineffective for removing color from the wastewater. Wood has high absorptive capacites for dyes and is relatively cheap, and so may have potential for use in color removal. Decolorization of a dilute solution of a basic dyestuff (Astrazone Blue) was carried out by using hardwood sawdust as adsorbent. Hardwood contains higher percentage of hemicellulose and lignin and consequently contains mor acidic groups than soft wood, and therefore may have more affinity towards the adsorption of basic dyes. At 80 C, 85% decolorization occurred within 100 min at an inital concentration (Co) of 200 mg/cu dm. As the wood particle size decreased, the amount of dye adsorbed increased. There was a 44% reduction in contact time when the temperature was raised from 25 to 80 C. The activation energy of the process was 9.83 kJ/mol which shows that the rate controlling step is intraparticle diffusion. (Moore-IVI)
W85-06659

MAIN DIRECTIONS IN PROTECTING WATERS FROM POLLUTION,
I. M. Kutyrin.
Hydrotechnical Construction, Vol. 18, No. 9, p 451-453, September, 1984. 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 56-57, September, 1984.

Descriptors: *Water pollution control, *Industrial wastewater, *Wastewater renovation, Wastewater treatment, Refineries, Water reuse.

The introduction of closed-cycle water-supply systems at industrial enterprises, having ecological and economic virtues, is a complex process requiring the development and persistent introduction of new technological processes and equipment or their improvement. One of the universal methods in organizing a closed-cycle water supply is the wide use of a recycled water supply, which markedly reduces the use of fresh water and its consumption per unit product, thus reducing the volume of wastewaters formed. An essential measure ensuring the normal operation of recycled water-supply system is treatment of the water for these systems: suspended solids, slag, organic and other specific substances, for example, oil, are subject to removal from process, waste, and other waters. In all cases when converting to a closed-cycle system it is necessary to group watstewaters with consideration of the specific characteristics of their pollutants, to discharge and treat them separately, and also to increase general production efficiency and especially to eliminate all losses owing to faulty equipment. A considerable reduction of water pollution in the future seems possible by industrial wastewater producers through the use of recycled water supply systems at enterprises and introduction of closed-cycle technological processes of the main types of industry. (Baker-IVI)
W85-06712

PERCOLATION TESTS, SOIL TEXTURE, AND SATURATED HYDRAULIC CONDUCTIVITY IN LACUSTRINE SOILS IN NORTH DAKOTA,
Virginia State Dept. of Health, Richmond.
For primary bibliographic entry see Field 2G.
W85-06717

MODEL FOR AUTOTHERMIC AEROBIC DIGESTION, EFFECTS OF SCALE DEPENDING ON AERATION EFFICIENCY AND SLUDGE CONCENTRATION,
Politecnico di Milano (Italy). Ist. di Ingegneria Sanitaria.
R. Vismara.
Water Research, Vol. 19, No. 4, p 441-447, 1985. 6 Fig, 23 Ref.

Descriptors: *Wastewater treatment, *Aerobic digestion, Sludge, Temperature, Model studies, Oxygenation, Sludge thickening, Efficiency.

A single stage stabilization process is proposed with an 8 day retention time and diffused aeration for the sole purpose of good sludge stabilization. The effect of variations in the efficiency of the aerators is negligible in winter conditions with small reactors and solid concentrations below 2%. The effect of scaling up is considerable for soil concentrations less than 2% and is appreciable for solid concentrations of 5% and reactor volumes of less than 5 cu m. Even in winter conditions and solid concentrations of below 2%, a reactor temperature of 20 degrees is obtained with ordinary aeration systems. Higher temperatures can be reached by using particular aeration systems available on the market with oxygenation efficiencies around 20%. It is essential both to thicken the sludge and to have an efficient oxygenation if higher temperatures and more ambitious objectives are to be reached. Satisfactory oxygenation can be obtained only with tandem blowing or aspiration in submerged mixers, or with the latest systems of external aeration with ejectors and recirculation pumps. A check of the validity of the model with the experimental results obtained has shown an extremely good correlation between the calculated figures and the experimental results. (Baker-IVI)
W85-06731

SELECTION OF GROWTH RATE MODEL FOR ACTIVATED SLUDGES TREATING PHENOL,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich, A. F. Gaudy, Jr., and P. C. D'Adamo.
Water Research, Vol. 19, No. 4, p 481-490, 1985. 4 Fig, 8 Tab, 27 Ref.

Descriptors: *Activated sludge processes, *Phenols, *Wastewater treatment, Activated sludge, Organic compounds, Model studies, Kinetics.

A series of batch growth studies using biomass seeds from different heterogeneous populations were performed using phenol as the sole carbon source. When the fits of the five inhibition functions to the data were compared, it was determined that all five functions gave equivalent fits. Two of the functions contained four fittable constants. The inclusion of a fourth biokinetic constant exacerbates the task of fitting the data, so these additional equations were eliminated from further consideration. Two other equations contain terms which exponentiate S. The incorporation of these growth rate expressions into biological reactor mass balance equations produces unwieldy predictive equations, causing these two equations to be also eliminated. The Haldane function which contains only three fittable constants and produces relatively simple predictive equations when incorporated into reactor mass balance equations, was selected as the growth rate function for heterogeneous populations metabolizing phenol. Examination of the values of the biokinetic constants shows a singificant degree of variability; despite this variation, the results of the batch growth study tests provided a reasonable assessment of the value of mu* for the continuous flow chemostat fed phenol. By performing a series of batch growth studies it appears possible to estimate the critical operating parameters for biological treatment systems dealing with toxic or inhibitory wastes, and it seems reasonable to recommend that the approach taken using phenol should be tried on more complex phenolic wastes. (Baker-IVI)
W85-06735

ADSORPTION OF VARIOUS POLLUTANTS FROM AQUEOUS SOLUTIONS ON TO ACTIVATED CARBON,
Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
G. McKay, M. J. Bino, and A. R. Altamemi.
Water Resources, Vol. 19, No. 4, p 491-495, 1985. 10 Fig, 3 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Adsorption, *Activated carbon, Organic compounds, Phenol, Chlorophenol, Mercury, Chromium, Sodium dodecyl sulfate, Particle size.

The capacity of activated carbon for a certain type of pollutant is important for designing adsorption contacting systems. The ability of activated carbon, Filtrasorb 400, to adsorb pollutants from aqueous solutions was studied for the pollutants phenol, p-chorophenol, sodium dodecyl sulfate, mercuric ions and chromic(III) ions. Equilibrium isotherm analyses were undertaken using Langmuir and Freundlich equations. The Langmuir monolayer adsorption capacities for phenol, p-chlorophenol, sodium dodecylsulfate, mercuric ions and chromium ions onto carbon are around 213, 434, 361, 138 and 35 mg/g, respectively. The capacities show a small particle size dependence possibly due to the fact that the solute molecules cannot completely penetrate all the pores within the carbon particles. (Baker-IVI)
W85-06736

TREATMENT OF PESTICIDE-LADEN WASTEWATER BY RECIRCULATION THROUGH ACTIVATED CARBON,
Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
E. A. Kobylinski, W. H. Dennis, and A. B. Rosencrance.
ACS Symposium Series, Vol. 259, p 125-151, 1984. 10 Fig, 8 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Pesticides, *Activated carbon, Filtration, Recirculation, Model studies, Mathematical models, Thin layer chromatography.

The Carbolator 35B, a recirculatory carbon filtration system, successfully treated pesticide wastes in both pilot-scale and field tests. In pilot-scale tests, the system was challenged with 400 gallons of water containing 20, 60 and 100 mg/L of each of seven pesticides: baygon, dimethoate, diazinon, ronnel, malathion, dursban, and 2,4-D. The pesticide waste was pumped through the Carbolator and returned to the waste holding tank. The tank contents were analyzed by gas chromatography

and thin layer chromatography (TLC). A TLC method was developed to perform pesticide analysis in the field. A simple lab recirculating system using 4 liters of waste was also built to simulate the Carbolator system. A mathematical model was developed to predict the disapperance of the pesticides from the waste holding tank. The Carbolator carbon filtration system offers an economical and dependable means by which small waste generators can effectively treat their pesticide laden wastewater. The system is portable and can be assembled from commercial items with a capital cost of about $3,000. The system is simple to operate and with the aid of TLC it is easy to monitor. (Baker-IVI)
W85-06781

TREATING PESTICIDE-CONTAMINATED WASTEWATER; DEVELOPMENT AND EVALUATION OF A SYSTEM,
Purdue Univ., Lafayette, IN.
J. C. Nye.
ACS Symposium Series, Vol. 259, p 153-160, 1984. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Pesticides, *Pesticide applicators, Flocculation, Coagulation, Activated carbon, Adsorption.

A two-stage system was developed for removing pesticides from wastewater resulting when commercial pesticide applicators must wash application equipment after use. The first step in the treatment process is flocculation/coagulation using alum (aluminum sulfate) with the anionic polymer Watcon 1255. The flocculant is be superior in tests which demonstrated that 500 mg/l alum could reduce the concentration of metribuzin in water from 2,000-3,000 mg/l to about 1,000 mg/l. The final polishing step in treatment is passage of supernatant through Filtrasorb 300 (Calgon) activated carbon. The apparatus used for testing on the premises of commercial pesticide applicators employed a 55 gallon drum for flocculation and sedimentation followed by two carbon adsorption columns made from 4-8 inch diameter polyvinyl chloride sewer pipes. Two commercial pesticide applicators used the system for purifying water used to wash their equipment after use in aerial spraying of a wide variety of chemicals. Studies continued for two seasons at both sites, with all the washwater being collected after treatment and analyzed. The procedure developed effectively reduced the volume of waste that must ultimately be disposed of by a factor of 100 (5,000 gallons of wastewater to 50 gallons of sludge). At both sites, vegetation became established in areas that had been assumed to be sterile because of previous pesticide contamination. (Rochester-IVI)
W85-06782

NITROGEN AND PHOSPHORUS IN ROTORUA URBAN STREAMS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 5B.
W85-06796

ANAEROBIC WASTEWATER TREATMENT AND ITS POTENTIALS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
G. Lettinga.
European Water and Sewage, Vol. 89, No. 1067, p 22-27, January, 1985. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, Industrial wastewater, Economic aspects, Organic compounds, Reviews, Sludge, Biological wastewater treatment.

The anaerobic wastewater treatment alternative offers tremendous potentials for treating industrial liquid wastes, low strength as well as high strength. One of the main benefits of the process is its feature that energy is produced from the organic pollutants, whereas the energy needs of the process are nil. The loading potentials of an anaerobic wastewater treatment system are primarily dictated by the amount of viable sludge which can be retained in the anaerobic reactor and the amount of contact which can be achieved between the incoming waste water and the sludge. All modern high rate processes are based on some mode of bacterial sludge immobilization, namely: the formation of highly settleable sludge aggregates, combined with early gas separation and internal sludge settling; bacterial attachment to high density particulate carrier materials or to immobile support structures supplied to the reactor; or entrapment of sludge aggregate between packing material supplied to the reactor. Currently available high rate anaerobic treatment systems include the upflow anaerobic sludge blanket, the upflow anaerobic filter, the stationary anaerobic fixed film reactor, the anaerobic fixed film expanded bed, and the anaerobic fluidized bed reactor. Differences betweeen these processes are explored. The current use of high rate anaerobic wastewater treatment is reviewed along with the potentials and costs of such treatment. (Baker-IVI)
W85-06812

EXTRA EFFORT WINS WATER QUALITY PAYOFFS,
Wisconsin Dept. of Natural Resources, Madison.
J. Smoller.
EPA Journal, Vol. 11, No. 3, p 14-15, April, 1985. 1 Fig.

Descriptors: *Wastewater treatment facilities, *Wisconsin, *Economic aspects, Legislation, Wastewater treatment, Water quality control.

Even with very active water quality control programs through the early 1970s, Wisconsin was still short of its water quality goals. In 1978 the legislature passed the Wisconsin Fund, a tax-supported grants program to bring municipal wastewter treatment systems into compliance with the Clean Water Act's July 1, 1983 deadline. There is general agreement today that the progress toward the 1983 goals made by most Wisconsin communities, and the progress still being made, would not have been possible without the Wisconsin Fund. With public support the Wisconsin Fund Point Source Program was enacted with little difficulty. The program parallels the federal grant program and covers up to 60% of the cost of constructing or upgrading wastewater treatment facilities. Brief examples of the use of the fund are offered. (Baker-IVI)
W85-06817

VERSATILE COMPUTER-CONTROLLED FERMENTOR FOR THE SIMULATION OF WASTEWATER TREATMENT SYSTEMS,
Leeds Univ. (England). Dept. of Civil Engineering.
N. J. Horan, C. R. Eccles, and D. D. Mara.
Process Biochemistry, Vol. 20, No. 1, p 13-16, February, 1985. 4 Fig, 8 Ref.

Descriptors: *Fermentors, *Wastewater treatment, *Computers, *Simulation, Activated sludge processes, Model studies, Anaerobic conditions.

A simple and inexpensive example of the interfacing of a microcomputer to a commercially available fermentor is presented. The system will allow the simulation of numerous wastewater treatment systems by fitting the appropriate data with an orthogonal polynomial. Software and hardware are discussed along with several practical applications in wastewater research. These applications include work in activated sludge processes, anaerobic digestion processes, and other processes involved in the treatment of wastewater. (Baker-IVI)
W85-06837

PRETREATMENT PLANT UNDER EVERY LAWN,
Clarida Consulting Engineering Services, Marion, IL.
G. Clarida.
Water Engineering and Management, Vol. 132, No. 4, p 22-25, April, 1985. 2 Fig.

Descriptors: *Wastewater treatment, *Pretreatment, *Sewer systems, Lake of Egypt, Illinois, Wastewater collection, Pumps, Grinder pumps.

A low pressure wastewater collection system using an individual grinder pump station located at each household or business site provided an economical and efficient wastewater collection system for Lake of Egypt, Illinois. The sewage is ground into small particles and then pumped through small-diameter plastic pipe. Individual pumping systems were purchased as complete packages. Each station includes a Piranha grinder pump, galvanized steel piping with check valve, union and gate valve, a junction box with three level sensors, reinforced plastic basin with a bolted steel cover and a remote enclosed control panel with alarm lamp. Each grinder station package includes a control panel which includes full magnetic short circuit and overload protection, start and run capacitors, and signal lights indicating pump on, seal failure, and high water level. The wastewater treatment plant is very basic and consists of two 12-ft deep ponds in series, followed by a polishing filter. The primary pond has three surface aerators, and the secondary pond has two, all of which are used intermittently. Effluent discharge into the South Fork of the Saline River meets the state's standards of 10 mg/l BOD and 12 mg/l suspended solids. (Baker-IVI)
W85-06840

HEXAVALENT CHROMIUM REMOVAL IN A FOAM FLOTATION PILOT PLANT,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
S.-D. Huang, and D. J. Wilson.
Separation Science and Technology, Vol. 19, No. 8/9, p 603-611, July/August, 1984. 1 Fig, 5 Tab, 20 Ref.

Descriptors: *Wastewater treatment, *Chromium, *Industrial wastes, *Foam flotation, Pilot plants, Adsorption, Chemical reactions.

Chromium in industrial wastes often occurs in the hexavalent form as chromate and dichromate. Hexavalent chromium was removed from dilute simulated wastewater in a continuous flow pilot scale foam flotation plant. For direct discharges, the 30-day averaged standard for Best Practicable Control Technology Currently Available (BPT)-equivalent control technology is 1.0 ppm for chromium. The Best Available Technology Economically Achievable (BAT) provides a more stringent standard of 0.50 ppm. Removal of Cr(VI) by adsorbing colloid flotation in a continuous-flow pilot plant is described. Hexavalent chromium is reduced to Cr(III) with FeSO4, and the resulting mixed precipitate is removed by flotation with sodium lauryl sulfate. Effluent Cr concentrations below 0.3 mg/L were routinely obtained by this technique. (Baker-IVI)
W85-06842

USE OF VOLATILE CHLOROORGANICS AS A MEASURE OF THE REHABILITATION OF THE ST. LOUIS RIVER AND BAY,
Minnesota Univ., Minneapolis. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W85-06867

RESIDUE LEVELS OF ORGANOCHLORINE INSECTICIDES IN SEWAGE PLANT EFFLUENT,
Biological Research Center, Baghdad (Iraq). Dept. of Environmental Pollution.
For primary bibliographic entry see Field 5B.
W85-06875

CHEMICAL CLARIFICATION METHODS FOR CONFINED DREDGED MATERIAL DISPOSAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
P. R. Schroeder.
Technical Report D-83-2, Final Report, July 1983. 147 p, 35 Fig, 21 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Dredging, *Suspended solids, *Sediments, *Clarification, *Flocculation, Polymers, Chemical treatment, Polyamines, Effluents, Turbidity, Settling basins.

Thirty-five chemicals were screened in the laboratory to determine which types of polymer were most effective in clarifying suspensions of fine-grained, freshwater sediments involved in dredging. The moderately high molecular weight, highly cationic polyamines performed well on the suspensions tested (concentrations 0.21-2.1 g per liter). The optimum technique, developed during field trials, was dispersion of a concentrated, low viscosity liquid polymer in the effluent at the weir of the primary containment area. The polymer was diluted in-line with supernatant from the containment area as it was being pumped to the weir. Mixing occurred in the weir. Settling and storage was provided in a small secondary containment area. Solids concentration was reduced from 2 g per liter to 50 mg per liter at a polymer dosage of 10 mg per liter. When polymer was injected into the dredge pipelines, the required dosage was much higher than when effluents were treated. Guidelines are given for designing the components of the treatment system.
W85-06914

FIELD INVESTIGATIONS OF OVERLAND FLOW TREATMENT OF MUNICIPAL LAGOON EFFLUENT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. E. Peters, C. R. Lee, and D. J. Bates.
Technical Report EL-81-9, September 1981. Final Report. 304 p, 41 Fig, 37 Tab, 52 Ref, 14 Append.

Descriptors: *Wastewater treatment, *Overland flow, *Wastewater renovation, *Lagoons, Advanced wastewater treatment, Effluents, Coliforms, Heavy metals, Metals, Land disposal, Wastewater disposal, Vegetation, Nutrient removal.

Overland flow to provide advanced treatment of municipal lagoon effluent was studied in a field environment near Utica, Mississippi. The field studies were conducted on slopes constructed at 2,4, and 8% and seeded with a mixture of four grass species. Wastewater from a facultative lagoon was applied to the surface in measured amounts, and surface runoff was collected and metered at the end of each plot. The effectiveness of overland flow to renovate municipal wastewater with respect to biochemical oxygen demand, total suspended solids, nutrients, fecal coliforms, and heavy metals was studied over approximately a 3-yr period. Samples of surface runoff and subflow were analyzed for several operational conditions with variable depths of wastewater application, period, and frequency of application per week. The roles played by soil, soil temperature, vegetative cover, and management in wastewater renovation by overland flow were also investigated. Because of interest in cost recovery from land treatment systems through marketing of the vegetative cover for animal feed, results of dry matter yield of grass for the various operational conditions were determined. Several specialized studies within the broader research goals were conducted to answer questions related to algae reduction, enhanced phosphorus removal by alum addition, characterization of stormwater runoff from overland flow systems, fecal coliform reduction, and nitrogen losses through volatilization of ammonia. Recommendations for the construction and operation of overland flow systems are given. (Author)
W85-06926

ACTIVATED SLUDGE PROCESS: FUNDAMENTALS OF OPERATION,
Weston (Roy F.), Inc., West Chester, PA.
R. Junkins, K. Deeny, and T. Eckoff.
Butterworth, Boston. 1983. 136 p.

Descriptors: *Wastewater treatment, *Activated sludge process, *Operations, Sewage bacteria, Microorganisms, Microbiology, Biochemical oxygen demand, Organic matter, Biological wastewater treatment, Nutrients, Detention time, Dissolved oxygen, Toxicity, Temperature, Hydrogen ion concentration, Mixing, Aeration, Flow rate, Plug flow, Oxidation ditches, Kraus process, Hatfield process, Monitoring, Chemical oxygen demand, Settleable solids, Sludge, Organic loading, Chemical treatment, Ammonia, Phosphoric Acid, Bulking sludge, Flocculation, Wastewater analysis, Mechanical equipment, Training.

This handbook on activated sludge process operation is written for operators, supervisors, and engineers. The process mechanics are explained, including the basic mechanism of the process, the formation of activated sludge, the growth and classification of microorganisms, and solids separation and return. Factors affecting operation are the raw wastewater strength, nutrients, dissolved oxygen, detention time, pH, toxicity, temperature, mixing, and flow rate. Several modifications of the process are available: plug flow, complete mix, contact stabilization, extended aeration, oxidation ditch, and others. Visual and analytical indicators are used for monitoring. For optimum performance the operator must consider plant loadings, the food/microorganism ratio, sludge age, sludge wastage rate control, sludge recycle rate control, and chemical feed rates. A general scheme for troubleshooting operating problem is given. Typical operating problems are low soluble BOD removal, organic loading, toxic or inhibitory substances, low temperatures, pH out of range, insufficient aeration time, insufficient mixed liquor volatile suspended solids, rising sludge versus bulking sludge, deflocculation, straggler floc, pin floc, and solids carryover. Pre-startup procedures include wastewater analysis, selection of seed microorganisms, equipment check, and familiarization and training. Actual startup begins with seeding of the microorganisms, followed by process monitoring, microscopic examination of the mixed liquor, settling tests, and post startup checklist. Some problems encountered during startup are foaming, settling problems, and low BOD removal.
W85-06932

WATER REUSE THROUGH GROUNDWATER RECHARGE IN NORTHEASTERN ILLINOIS,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
G. E. Stout, T. F. Naymik, T. H. Larson, and M. R. Schock.
Research Report No. 184, September 1984. 83 p, 41 Fig, 2 Tab, 52 Ref. Project No. Bu Rec R-0061, Contract/Grant No. 14-34-0001-7811 (1).

Descriptors: *Water reuse, *Wastewater treatment, *Artificial recharge, Sanitary plant effluent, Effluent characteristics, Effluent movement, Recharge pit, Aquifers, Filter media, Model simulation, Illinois, Mathematical models.

This study was designed to examine the advantages, disadvantages, and effects of artificial recharge, using sanitary plant effluent as recharge water. A numerical groundwater model was constructed for a site near Aurora, Illinois, and validated by simulating an aquifer test at a proposed pit location. Model simulations were also conducted to calculate the flow capacity of the system, the flow capacity of a pilot recharge pit, and the solute transport through and away from the pit. Based on the study's findings, a pilot pit should be constructed at the Aurora Site, and chemical quality of the water withdrawn from the operation would be the research aspect of a pilot pit. There may be some characteristics of the effluent, such as the total dissolved solids (TDS), that exceeds the background counts of the aquifer. A TDS of 100 mg/l, which is considered excessive for many water supply uses but neither is toxic nor creates a health hazard in the effluent, could be reduced through demineralization, but this is an additional cost. Furthermore, the sole purpose of this study was to evaluate the movement and changing characteristics of the high quality effluent from tertiary-treated wastewater which is primarily domestic in nature as this effluent moves through from a pit into the aquifer. Artifical recharge is a viable concept as shown by the calculations and model simulations of the Aurora site.
W85-06941

EVALUATION OF WASTEWATER DISINFECTION ALTERNATIVES,
Ontario Ministry of the Environment, Toronto. Wastewater Treatment Section.
F. A. Tonelli, K. W. Ho, and N. N. W. Schmidtke.
Research Report No. 106, 1981. 173 p, 29 Fig, 26 Tab, 7 Ref, 7 Append. Project No. 74-1-33, 74-3-17.

Descriptors: *Disinfection, *Chlorination, *Wastewater treatment, Chlorine, *Cost analysis, *Ozonation, *Toxicity, *Water pollution effects, Chlorine, Ozone, Chlorine dioxide, Coliforms, Dechlorination, Municipal wastewater, Comparison studies, Trout.

Small scale tests of the efficacy of chlorine, chlorine dioxide and ozone as disinfectants for three types of municipal wastewater effluents (non-nitrified, nitrified, and denitrified) were carried out under field conditions. All three disinfectants reduce the total coliforms to selected target levels of 2000 total coliforms/ml. Cost analyses showed that chlorine had the lowest projected use-cost. Ozone had a slightly higher projected use-cost than chlorine dioxide for low quality effluents at small treatment facilities, but improved effluent quality and larger treatment plant size made ozone more economical. Dechlorination can help to eliminate the acute toxicity of chlorinated wastewaters. Ozonation produced non-acutely toxic effluents and is recommended for use at oxygen-activated sludge plants. Effluents treated with chlorine dioxide were acutely toxic to juvenile rainbow trout. However, the cost of chlorine residual removal results in use-costs which are much higher than the cost of chlorine disinfection plus dechlorination.
W85-06963

PARASITES AND THE LAND APPLICATIONS OF SEWAGE SLUDGE,
Ontario Ministry of the Environment, Toronto. Pollution Control Branch.
H. J. Graham.
Research Report No. 110, 1981. 84 p, 7 Fig, 12 Tab, 97 Ref, 2 Append. Project No. 74-1-41.

Descriptors: *Sludge disposal, *Parasites, Land disposal, Domestic animals, Pastures, Cultivated lands.

A study was conducted to determine the incidence of parasites in Ontario sewage sludges and the length of time and the ova and/or cysts of these parasites remain viable. Parasite ova, mainly Ascaris and Toxocara, were recovered from many Ontario sewage sludges, and from sludged fields. These ova can survive on pasture for several years, are probably destroyed on bare soil within 1 yr. and possibly survive only a few weeks when the sludge is mixed with the soil. This information, together with the type of parasites present in Ontario and the numbers found in the digested sludge, make noticeable parasite transmission, via sludge spread on farmland, a remote possibility. The following recommendations are directed to personnel who actually apply the sludge to the farm fields: a) ingestion of, or food contamination with, liquid sludge should be prevented; b) food contamination with dry sludge should be avoided due to the probable presence of infective ova of Ascaris, Trichuris and Toxocara; and c) skin contact with sludge from a drying bed should also be avoided due to the possible presence of hookworm larvae. With respect to sludge applied to pasture, if subsurface-injection is used, and no sludge remains on the surface, there should be no restrictions on use of the pasture. The threat of parasitic infection from digested sludge to domestic animals is far less than that of acquiring infections in the normal farm environment. The exception is Taenia saginata which can only be transmitted to cattle by human fecal contamination. The parasite ova are unlikely to last longer than one year except in moist, shaded soil, where a two-year waiting period is necessary.
W85-06978

IRRADIATION AS AN ALTERNATIVE FOR DISINFECTION OF DOMESTIC WASTE IN THE CANADIAN ARCTIC.
International Environmental Consultants Ltd., Islington (Ontario).
Report SCAT-6, 1981. Environment Canada, Canada Mortgage and Housing Corporation,

Ottawa, Ontario. 101 p, 14 Fig, 31 Tab, 35 Ref, 2 Append.

Descriptors: *Disinfection, *Irradiation, *Domestic wastes, *Arctic, *Wastewater treatment, *Gamma radiation, Municipal wastes, Arctic zone, Wastewater, Capital costs, Operating costs, Environmental impact statement.

The purpose of this study was to evaluate the technical and economic feasibility of various methods for disinfecting wastewater in the Canadian Arctic with specific reference to gamma radiation. More conventional disinfection practices, such as chlorination, chlorination-dechlorination, and ozonation were compared to gamma radiation along with ultraviolet (UV) irradiation and lime (pH) disinfection. The quality of lagoon effluent, highly diluted (weak) sewage, holding tank wastes and honey-bag wastes, which are the typical waste types found in northern communities, was established from data available in the literature. Further literature reviews were undertaken to establish a data base for design and effectiveness of disinfection systems operated in cold climates. Capital and operating costs for all technically feasible disinfection process alternates were estimated based on historical cost data adjusted to 1977 for the construction and installation of similar systems in the north. The costs of equipment, chemicals, fuel, and electrical power were obtained from suppliers. The environmental impact of each of the disinfection processes was reviewed with emphasis on gamma irradiation. Safety and health aspects were also considered. The study concluded that gamma irradiation was capable of providing safe, reliable disinfection for concentrated honey-bag and holding wastes. Pilot-scale testing was recommended prior to construction of full-scale disinfection facilities. For lagoon effluents and weak sewage, gamma irradiation was not cost competitive with other alternates; rather chlorination-dechlorination was found to be the most cost-effective and environmentally acceptable alternative.
W85-06982

OPTIMIZATION OF BIOLOGICAL RECYCLING OF PLANT NUTRIENTS IN LIVESTOCK WASTE BY UTILIZING WASTE HEAT FROM COOLING WATER,
Tennessee Valley Authority, Muscle Shoals, AL. Div. of Agricultural Development.
J. J. Maddox, L. L. Behrends, D. W. Burch, J. B. Kingsley, and E. L. Waddell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-107763. EPA-600/7-82-041, May 1982. 141 p. 15 Fig, 34 Tab, 166 Ref, 1 Append. Contract/Grant No. IAG-DO-E721-BF and TV-41967A.

Descriptors: *Recycling, *Waste recovery, *Livestock wastes, *Waste heat, *Cooling water, *Anaerobic digestion, Aquaculture, Wastewater farming, Hydroponics, Fertilization.

This report presents results from a 5 yr study to develop aquatic methods which beneficially use condenser cooling water from electric generating power plants. A method is proposed which uses a system for aquatic farming. Livestock waste is used to fertilize planktonic algae production and filter-feeding fish are used to 'biologically harvest' the algae, condenser cooling water (simulated) is used to add 'water heat' to the system, and emergent aquatic plants are used in a flow through series as a biofilter to improve the water quality and produce an acceptable discharge. Two modes of operation were tested; one used untreated swine manure as the source of aquatic fertilizer and the other uses anaerobic digester waste as a means of pretreating the manure to produce an organic fertilizer. A set of operating conditions (temperature, retention time, fish stocking rate, fertilizer rates, land and water requirements, suggest fish and plant species, and facility design) were developed from these results. The integrated system allows continual use of power plant condenser cooling water from plants in the southeastern United States.
W85-06983

PROCEEDINGS OF STORMWATER AND WATER QUALITY MODEL USERS GROUP MEETING: JANUARY 27-28, 1983.
Environmental Protection Agency, Athens, GA.
For primary bibliographic entry see Field 5G.
W85-06999

WASTEWATER CHARACTERISTICS,
Helsinki Univ. of Technology, Espoo (Finland). Lab. of Pulping Technology.
N.-E. Virkola, and K. Honkanen.
Water Science and Technology, Vol. 17, No. 1, p 1-28, 1985. 15 Fig, 9 Tab, 33 Ref.

Descriptors: *Pulp and paper industry, *Wastewater treatment, *Water reuse, Biochemical oxygen demand, Color, Total organic carbon, Chemical oxygen demand, Toxicity, Suspended solids, Water pollution control.

One of the most common internal arrangements reducing pollution loads caused by pulp and paper mills has been the closure of water circulation systems. The decrease in pollution loads is not the only reason for closure. The consumption of raw materials and energy and effluent treatment costs also decrease. Total closure of water systems causes many problems and extra costs, so each mill must find its own solution for economical internal and external treatment of effluents. Various possibilities for reducing the bleaching discharges have been explored but no solution found as yet. One solution called for chlorine-free bleaching. This would allow the water systems of the bleachery to be closed effectively without the accumulation of salt in the pumping chemical recovery cycle. The toxicity of bleaching effluents would also decrease significantly. The pollution load from debarking accounts for a large proportion of the total pollution load, especially in a paper or board mill integrated with a mechanical pulp mill. In such an integrate, the mechanical pulp mill also accounts for a large part of the pollution load. The pollution load caused by the paper of board mill itself is minimal, but the effluent volume is usually great. In chemical pulp mills, the pollution load originates mainly from foul condensates of the digester room and the evaporation of spent cooking liquor and from bleaching effluents. About 50-60% of the total BOD7 load originates from the bleachery of the pulp mill. Active research and development is required to minimize the pollution loads of pulp and paper mills in the most efficient and economical way. (Baker-IVI)
W85-07001

CHARACTERISTICS OF PAPER/BOARD MILL WASTEWATERS RELEVANT TO ANAEROBIC TREATMENT,
Pira, Leatherhead (England).
L. J. Webb.
Water Science and Technology, Vol. 17, No. 1, p 29-38, 1985. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Pulp and paper industry, *Wastewater treatment, Acidity, Temperature, Anaerobic digestion, Economic aspects, Biodegradation, Sulfates.

The characteristics of papermaking wastewaters are wide-ranging, a reflection of the diverse range of products classified as paper and the range of additives used in their manufacture. In terms of biological treatment generally, the dissolved organic components of papermaking effluents are biodegradable. The major hazard in conventional aerobic treatment concerns poor housekeeping and/or spillages from the use of biocides. Additional factors are important in determining the suitability of a particular wastewater for anaerobic treatment, notably wastewater strength, temperature and sulfate concentration. It seems likely that the most suitable wastewaters will be generated by mills using a high proportion of wastepaper and/or starch, with a substantially closed water system, and using a synthetic neutral sizing system in preference to alum/rosin. Given a treatable wastewater, the economic vaiability of anaerobic treatment will depend on a mill's scale or operation, its existing treatment system and the effluent standard required for discharge. In most circumstances, anaerobic treatment is likely to be cheaper to install and operate than aerobic plants, giving pay-back periods of 2-3 years in the most favorable cases. (Baker-IVI)
W85-07002

ANAEROBIC BIOLOGICAL DECOMPOSITION OF MALODOROUS COMPOUNDS IN KRAFT PULPING WASTEWATER,
Ebara-Infilco Co. Ltd., Fujisawa (Japan). Research Center.
G. Endo, and Y. Tohya.
Water Science and Technology, Vol. 17, No. 1, p 39-52, 1985. 7 Fig, 6 Tab, 3 Ref.

Descriptors: *Anaerobic degradation, *Kraft mills, *Pulp and paper industry, Biological wastewater treatment, Odor control, Acidity, Temperature effects, Hydrogen sulfide, Methyl mercaptan, Dimethyl disulfide, Decomposition.

The capability and performance of anaerobic biological decomposition of malodorous coumpounds in kraft pulping waste stream drains were studied, and one of the most economical processes for both BOD removal and prevention of malodorous air pollution was developed. The experimental apparatus used was a bench scale semi-batch anaerobic contact process in which a digester vessel was operated in regular sequence as a stirred digester and a stationary sedimentation tank. The digesting anaerobic sludge could convert dimethyl disulfide (DMDS) to methyl mercaptan (MM) and that the latter was partially decomposed to hydrogen sulfide (H2S). To maintain this anaerobic biodegradation of sulfur-containing malodorous compounds, the concentration of hydrogen sulfide in digester mixed liquor was required to be kept below about 5 mg/L. The conditions of temperature of 50 degrees and pH of 6.5 were most suitable for the methane fermentation of the kraft pulping waste stream drainage and for the removal of the malodorous compounds. Scrubbing of the digester head space gas with the solution of sodium hydroxide removed not only H2S but also MM so that a high removal rate of DMDS and MM was achieved. Unfortunately, dimethyl sufide could not be decomposed biologically, but it could be removed easily with a simple air stripping process. (Baker-IVI)
W85-07003

ANAEROBIC WASTEWATER TREATMENT PROCESSES,
Helsinki Univ. of Technology, Espoo (Finland). Dept. of Forest Products.
R. K. Maatta.
Water Science and Technology, Vol. 17, No. 1, p 53-59, 1985. 5 Fig, 3 Ref.

Descriptors: *Wastewater treatment, *Finland, *Anaerobic digestion, *Pulp and paper industry, Biodegradation, Biological wastewater treatment, Kraft mills, Dairy industry.

The first biological waste water treatment plants in Finland for municipal sewage were anaerobic septic tanks. The first anaerobic reactor for industrial waste water was designed in Rajamaki in the 1930's for the treatment of effluents from an alcohol distillery. Three different types of anaerobic treatment plants exist in Finland today for the treatment of sugar wastewaters, dairy wastewater, and pulp bleaching wastewater. The biochemistry and process condition of anaerobic fermentation are reviewed. Anaerobic metabolism is regarded as a three step process: hydrolysis of suspended or soluble organics of high molecular weight, degradation of small molecules to various volatile fatty acids, and production of methane. The four metabolic groups which function in anaerobic fermentors include the hydrolytic bacteria which ferment different complex organic compounds into a broad spectrum of end products; the hydrogen producing acetogenic bacteria which include both obligate and facultative species that can ferment organic acids larger than acetic, and neutral compounds larger than methanol to hydrogen and acetate; the homoacetogenic bacteria which can ferment a very large number of multi or one carbon compounds to acetic acid; and the methanogenic bacteria which

ferment H2/CO2, one carbon compounds and acetate into methane. In the treatment of sludge the biological and the hydraulic retention times are almost identical. (Baker-IVI)
W85-07004

APPLICATION OF THE UASB-REACTOR FOR ANAEROBIC TREATMENT OF PAPER AND BOARD MILL EFFLUENT,
Burhrmann-Tetterode N.V., Doetinchem (Netherlands).
L. H. A. Habets, and J. H. Knelissen.
Water Science and Technology, Vol. 17, No. 1, p 61-75, 1985. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Pulp and paper industry, *Wastewater treatment, Anaerobic digestion, Biological wastewater treatment, Netherlands.

In April of 1983 a 70 cu m practical scale USAB reactor was started up at a solid board mill at Ceres in the Netherlands. In October of 1983 a full scale plant was started up at Papierfabriek Roermond. This plant consists of a 1,000 cu m UASB reactor and a 70 cu m gas holder. It is used for pretreatment of effluent, in order to reduce the loading of the activated sludge plant. Besides energy savings on the oxygen input, about 1 million cu m/year of biogas is being generated and is used for steam production. Both plants are working satisfactorily. Investment costs appeared to be relatively low. At Ceres, payout time is 1.5 year, while at Papierfabriek Roermond wastewater treatment is cheaper than before, although capacity is doubled. Start-up can be completed in about 3 or 4 months. In case adapted granular sludge is available, start-up only lasts for several weeks. From the results achieved it is expected that application of anaerobic treatment in paper and board producing industries will greatly increase during the next few years. (Baker-IVI)
W85-07005

FLUIDIZED BED TECHNOLOGY IN THE ANAEROBIC TREATMENT OF FOREST INDUSTRY WASTEWATERS,
Helsinki Univ. (Finland). Dept. of Microbiology.
M. S. Salkinoja-Salonen, R. Hakulinen, L. Silakoski, J. Apajalahti, and V. Backstrom.
Water Science and Technology, Vol. 17, No. 1, p 77-88, 1985. 10 Fig, 4 Tab, 11 Ref.

Descriptors: *Fluidized bed process, *Wastewater treament, *Pulp and paper industry, Anaerobic conditions, Bleaching wastes, Industrial wastes, Sulfites.

Anaerobic treatment has been shown to be successfully applied to various wastewater streams from the pulp and paper industry. It alone removed 80 to 90% of BOD5 and also of COD-Cr unless the effluent in question contains lignin, which is slowly, if at all, biodegradable anaerobically over the periods of time that are applicable in industrial wastewater treatment. With bleaching wastewater, about 30% of the COD-Cr was biodegradable anaerobically, and a removal efficiency of about 50% could be obtained if aerobic post-treatment was applied. Anaerobic fluidized bed reactor removed 3 to 4 kg of COD-CrO2/cu m reactor volume/d from sulfite pulp evaporator condensate, thermomechanical pulp mill wastewater and bleaching wastewaters from sulfite pulping and displacement bleaching of kraft pulp. These results were obtained with a fluidized bed reactor, where much of the biomass is attached to a small sized support material. A biomass support is essential when high hydraulic loading is needed. With very high strength wastes, when a longer hydraulic retention can be permitted, similar COD removal is possible also with conventional large-scale digesters. (Baker-IVI)
W85-07006

ANAEROBIC TREATMENT OF WASTEWATER FROM THE PRODUCTION OF CHEMI-THERMOMECHANICAL PULP,
Lund Univ. (Sweden). Chemistry Centre.
T. Welander, and P.-E. Andersson.
Water Science and Technology, Vol. 17, No. 1, p 103-111, 1985. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Pulp wastes, *Chemi-thermomechanical pulp, *Anaerobic digestion, *Hydrogen peroxide, Anaerobic conditions, Pilot plants, Biological wastewater treatment.

In order to find a solution to the peroxide toxicity problem, the possibility of removing hydrogen peroxide from chemi-thermomechanical pulp, (CTMP) waste water by means of an acidogenic reactor was investigated. The acidification of CTMP wastewater containing various concentrations of peroxide was studied. The degradation of hydrogen peroxide in a continuously inoculated biocatalytic prestage was studied along with the use of the redox potential for process control. Initially the waste water was completely inhibitory to the methanogenic microflora, even after the removal of hydrogen peroxide. After several months of adaptation, though, an increase in methanogenic activity was obtained. Microscopic examination revealed that a dramatic change had occurred. The predominating acetoclastic methanogen in the inoculum, a filamentous rod, had disappeared and been replaced by large clusters of a Methanosarcina-type of organism. The anaerobic treatment of CTMP waste water was studied in a pilot plant at the CTMP Hill in Ostrand. The pilot plant consists of two anaerobic stages, followed by an aerobic polishing stage. The COD reduction in the anaerobic part of the treatment process has been 50-60% and the methane yield has been about 0.3 cu Nm/kg COD reduced. The loading rate has been low, though, due to poor sludge retention and a low bacterial growth rate. (Baker-IVI)
W85-07007

STUDIES OF ANAEROBIC TREATMENT OF SULFITE PROCESS WASTES,
Washington Univ., Seattle. Dept. of Civil Engineering.
J. F. Ferguson, and M. M. Benjamin.
Water Science and Technology, Vol. 17, No. 1, p 113-121, 1985. 4 Fig, 1 Tab, 8 Ref. OWRT project 145-01-11N-39943-3068 and EPA grant R-808675-01-1.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Sulfite liquors, *Pulp wastes, Toxicity, Biological wastewater treatment, Costs, Mathematical models, Organic compounds.

A series of lab studies of treatment of sulfite process wastes constitute a case study of application of high rate anaerobic biological treatment. Sulfite evaporator condensate (SEC) was evaluated in batch and continuous flow studies to find the efficiency of treatment that was possible and the conditions suitable for treatment. A great deal of effort was expended on understanding potential limitations of high-rate anaerobic treatment. The requirement for and the cost of neutralization was addressed through mathematical modeling, and eventually by treating caustic extraction stage bleaching wastes in combination with SEC. The possible effects of sulfur were identified as potential toxicity, increases in effluent COD loss of methane production, and increased neutralization requirement. Lab studies reviewed point to a suitable way to approach evaluation of anaerobic treatment at a particular pulp and paper mill. There are significant research questions about application of anaerobic treatment to waste streams containing chemically modified organic compounds. Each case must be met with careful examination. Lab studies with batch or small continuous reactors are suitable for dealing with questions of toxicity, treatability and neutralization of waste streams prior to undertaking pilot plant studies. (Baker-IVI)
W85-07008

OPERATIONAL EXPERIENCE WITH ANAEROBIC/AEROBIC TREATMENT SYSTEM FOR PAPER MILL WASTEWATER,
Inland Container Corp., Newport, IN.
C. J. Priest.
Water Science and Technology, Vol. 17, No. 1, p 123-132, 1985. 1 Fig, 7 Tab.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Pulp and paper industry, Settling basins, Aeration, Biomass, Methane, Biochemical oxygen demand.

Operation at a paper mill in Indiana began in 1975. The initial effluent treatment system consisted of aeration stabilization and settling basins. The Wabash River was the recipient for the waste system discharge. Primary solids from the clarifier were recycled to the mill. Secondary solids from the settling basins were applied to farm land. An anaerobic plant pilot study was conducted in 1978. The results of that study brought about the approved conversion of the Newport effluent treatment system to an anaerobic/aerobic system. In November 1978 one aeration basin was converted to an anaerobic cell. In May of 1979 the anaerobic pond was 80% BOD reduction. Total effluent system efficiency has averaged 98% over the past 3 years. Aerobic biomass generation has been reduced 80 to 90% as measured by settleable solids. (Baker-IVI)
W85-07009

TAMAN ANAEROBIC PROCESS - FOR WASTEWATER FROM MECHANICAL PULP AND PAPER PRODUCTION,
Tampella Oy A.B., Tampere (Finland).
S. Rekunen, O. Kallio, T. Nystrom, and O. Oivanen.
Water Science and Technology, Vol. 17, No. 1, p 133-144, 1985. 7 Fig, 5 Tab, 2 Ref.

Descriptors: *Pilot plants, *Anaerobic wastewater treatment, *Pulp and paper industry, Activated sludge process, Wastewater treatment.

The prospects for application of anaerobic technology in the treatment of wastewater from the pulp and paper industry is an important area of research, for the anaerobic method is one of the few in which a significant share of the operating costs can be covered with a by-product (biogas) generated in the process. Laboratory and pilot plant tests show that the anaerobic technique can be used to treat combined wastewater from mechanical pulp manufacture, paper manufacture and the debarking plant. The Taman multi-stage reactor yields better treatment results than the control reactors operating on the UASB and completely mixed principles. The operating costs of the anaerobic process are less than 10% of the corresponding costs from an activated sludge plant, while the investment is of the same magnitude. (Baker-IVI)
W85-07010

ANAEROBIC TREATMENT OF SULFITE PULP MILL EFFLUENTS,
Technische Univ., Vienna (Austria). Inst. fuer Wasserguete und Landschaftswasserbau.
H. Kroiss, K. Svardal, and H. Flekseder.
Water Science and Technology, Vol. 17, No. 1, p 145-156, 1985. 7 Fig, 4 Tab, 2 Ref.

Descriptors: *Sulfites, *Wastewater treatment, *Pulp and paper industry, Industrial wastes, Methanogenesis, Sulfur dioxide, Anaerobic wastewater treatment, Pulp wastes.

Sulfite pulping will still play an important role in Austria in the foreseeable future. Therefore, efficient and economic means of wastewater treatment have to be searched for. The experience gained with operating laboratory scale and semi-technical scale experiments for anaerobic treatment of condensates and the extraction stage effuent from two mills is presented. The main reason for the inhibition of methanogenesis in these mills was the varying and high concentration of sulfur dioxide in the raw condensate. Up to now the investigations have shown that the condensate of the mill can be treated by the anaerobic process with a possible reduction of the biodegradable COD of even more than 90%. Under technical conditions a series of problems arises (neutralization, solids retention, sulfur dioxide toxicity, start-up of the process) which must be solved technically and considered economically before the final decision about the application of the anaerobic process is made. The advantage of the anaerobic process in terms of

energy alone cannot be the basis for such a decision. (Baker-IVI)
W85-07011

ANAEROBIC FERMENTATION OF SULPHITE PULP MILL EFFLUENTS,
Technische Hochschule Darmstadt (Germany, F.R.). Fachgebiet Papierfabrikation.
A. Geller, and L. Gottsching.
Water Science and Technology, Vol. 17, No. 1, p 157-171, 1985. 9 Fig, 4 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Sulfites, *Pulp and paper mills, Anaerobic digestion, Fixed bed processes, Biological wastewater treatment, Pulp wastes, Bleaching wastes.

Despite internal measures, modern sulfite pulp mills are still releasing considerable amounts of effluents loaded with organic pollutants. The main sources are the spent liquor evaporator and the bleach plant. In the laboratory scale two anaerobic systems (stirred fermentation vessel and fixed bed reactor) were tested for the fermentation of effluents from a magnesium sulfite mill. The efficiency of the fixed bed reactor was substantially better than the efficiency of the fermentor. Upon treatment of evaporator condensates, COD removal exceeded 90% with corresponding BOD removal of 99% after a residence time of 36 hours, whereas the necessary residence time for the same results was about 16 days in the fermentor. The methane production increased with increasing loading, reaching a maximum at a COD loading rate of 7 kg/cu m/day. BOD elimination from bleaching effluents was better than 95% with fixed bed reactor, while COD removal remained below 50%. All experiments were run over a period of more than two years, exhibiting stability of the fixed bed filter, low needs for maintenance and negligible biomass generation. The results of the experiments clearly show the disadvantages of the free moving, homogenously mixed biological solids: very low acclimation time, unstable treatment efficiency, and poor tolerance against high organic loading. (Baker-IVI)
W85-07012

PROCESS CONTROL IN ANAEROBIC WASTEWATER TREATMENT,
AC Biotechnics A.B., Arloev (Sweden).
B. Frostell.
Water Science and Technology, Vol. 17, No. 1, p 173-189, 1985. 1 Fig, 8 Tab. 50 Ref.

Descriptors: *Anaerobic digestion, *Biological wastewater treatment, *Process control, *Reviews, Temperature effects, Hydrogen ion concentration, Solids retention time, Microorganisms.

The monitoring and control of anaerobic waste water treatment are discussed. Optimum biological conditions are given for anaerobic treatment. These include a nutritionally balanced waste water free from oxidants and toxicants, a temperature of 55-60 degrees C, and a pH of 6.8-8.0. Parameters for monitoring and control are discussed. Present system designs usually allow for the control of influent flowrate and temperature but not for the key parameter, solids retention time (SRT). SRT is equivalent to the sludge age in aerobic treatment and is the average time that the microorganisms remain in the reactor during the treatment. In principal there are very few parameters that need control in anaerobic treatment. The real problem is that there are limited possibilities to control the process in a true sense. This is due to the fact that a waste treatment plant has to take what is offered and to the low growth rates of the microorganisms. (Baker-IVI)
W85-07013

ANAEROBIC TREATMENT OF SULFITE EVAPORATOR CONDENSATE IN A FIXED BED LOOP REACTOR,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie.
A. Aivasidis.
Water Science and Technology, Vol. 17, No. 1, p 207-221, 1985. 10 Fig, 2 Tab, 5 Ref.

Descriptors: *Microbial degradation, *Anaerobic digestion, *Fixed bed reactors, *Pulp wastes, *Evaporator condensate, Biological wastewater treatment, Process control, Biomass retention.

A disadvantage of microbial anaerobic degradation processes in waste water pretreatment lies in the relatively long doubling times of anaerobic microorganisms which cause long residence times in a continuous stirred tank reactor. Because of the autocatalytic behavior of the microbial processes and the low carbon incorporation rate which results in low biomass concentrations, decoupling of residence times for substrate and biomass in continuously operated systems is necessary. In this way high space time yields can be achieved under anaerobic conditions as well. Immobilization by an inert support is thought to be an effective alternative. Experiments on anaerobic treatment of sulfite evaporator condensate by means of immobilized microoganisms were carried out in a 12 l fixed bed loop reactor. Porous sinter glass with a porosity of about 60% and a mean pore diameter of 60-100 micro-m served as carrier. The reactor was operated for several months under steady state conditions at different residence times using an iterative approach. At a residence time of 11 hr 84% of the chemical oxygen demand was eliminated at loading rates up to 10 kg COD/cu m a day. On line data acquisition and process control are recommended and easily realized by means of a digital computer, in order to increase selection stress on microorgansim population and optimize space time yield. Extremely satisfactory results have been obtained to date for anaerobic wastewater purification indicating that this technology is basically suitable for a low cost energy- and space-saving treatment of industrial waste water. (Baker-IVI)
W85-07014

TREATMENT OF DIFFERENT WASTEWATERS FROM PULP AND PAPER INDUSTRY IN METHANE REACTORS,
Helsinki Univ. of Technology, Espoo (Finland). Dept. of Forest Products.
P. K. Latola.
Water Science and Technology, Vol. 17, No. 1, p 221-230, 1985. 6 Fig, 3 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Pulp and paper industry, Methane production, Anaerobic digestion, Biological wastewater treatment, Anaerobic filters, Microorganisms.

A wastewater from an integrated paper mill with a COD of 1200 mg/cu dm was anaerobically treated in a multi-stage reactor. The BOD7 removal efficiencies of 60-75% were achieved at maximal loading rates of 5-6 kg COD/cu m/d and HRT of 4-6 hr due to the granular sludge. The BOD7/COD-Cr ratio of the paper mill wastewater was only 0.5 on average, indicating that there exists a lot of biologically undegradable material in the wastewater. Industrial sulfite evaporator condensates from Ca- and Na- processes were treated in anaerobic filters containing light gravel, plastic foam and power plant slag as filter media. The BOD7 removals of 78% on average were achieved at loading rates of 1.8-3.3 kg COD/cu m/day with Ca-process evaporator condensates and 80% BOD7 removals were achieved with Na-process condensates at loading rates of 3.5-4.1 kg COD/cu m/day. Acclimation of microbiological population to a certain type of pulp and paper wastewater seems to be an important factor. This procedure will shorten startup periods and also give more secure treatment results. (Baker-IVI)
W85-07015

ANAEROBIC TREATMENT OF VISCOSE WASTEWATER,
Technische Univ., Vienna (Austria). Inst. fuer Wasserguete und Landschaftswasserbau.
H. Kroiss, F. Plahl-Wabnegg, and K. Svardal.
Water Science and Technology, Vol. 17, No. 1, p 231-239, 1985. 3 Fig, 3 Tab, 3 Ref.

Descriptors: *Anaerobic digestion treatment, *Viscose production, *Sulfates, Neutralization, Zinc, Wastewater treatment, Sulfur bacteria, Activated sludge process.

A treatment process for viscose wastewater is presented which consists of anaerobic pretreatment of the neutralized waste water combining the removal of carbonaceous matter with zinc removal by sulfide precipitation. The organic pollution of the wastewater is used as a substrate for sulfate reducing bacteria present in the anaerobic reactor. The hydrogen sulfide produced precipitates the zinc as insoluble zinc sulfide. Lab scale experiments lasting several months resulted in stable zinc effluent concentration below 1 mg/l combined with a COD removal of about 40-50%. The labscale experiments performed showed that full treatment of the viscose waste water can be carried out by two phase biological treatment: zinc removal in an anerobic upflow reactor, and aerobic final treatment in an activated sludge unit. With this treatment system it is possible to reach very low zinc-concentrations and BOD5 concentrations below 10 mg/l. As the anaerobic process needs only a pH of 6, the neutralization can be performed with limestone instead of lime, which means a 50% cost reduction. Sulfate reduction seems limited by the availability of easily biodegradable COD. The gas produced consists of CO2 and H2S. The excess sludge from anaerobic treatment consists of about 16% organic material and 84% inorganic compounds, of which about 17% are zinc, the rest mainly calcium carbonate precipitated in the reactor. The recovery of the zinc from the sludge is possible but has not been investigated in detail up to now. (Baker-IVI)
W85-07016

COSTS OF ANAEROBIC PROCESSES IN THE PULP AND PAPER INDUSTRY,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
G. K. Anderson, and A. U. Senaratne.
Water Science and Technology, Vol. 17, No. 1, p 241-254, 1985. 2 Fig, 9 Tab, 15 Ref.

Descriptors: *Anaerobic digestion, *Pulp and paper industry, *Costs, Reviews, Wastewater treatment, Sulfur compounds, Capital costs, Operating costs.

The advantages of using anaerobic treatment processes for treating wastewaters from the pulp and paper industry are described. The wastewater characteristics are outlined and a brief description given of the various anaerobic systems which are available. Problems associated with the presence of sulfur compounds and their solution are discussed and an example is described of the method of evaluating overall capital and operating costs. The available information indicates that the anaerobic treatment of industrial wastewaters, including those from the pulp and paper industry is a feasible and economical solution to many of the problems encountered. Consequently, anaerobic systems may be applied to these industries in order to satisfy the following requirements: recovery of a useable form of energy, reduction in pollution load, a cost effective solution for the minimization of production costs and for a potential low cost expansion of existing aerobic treatment processes. (Baker-IVI)
W85-07017

COST COMPARISON OF AEROBIC AND ANAEROBIC WASTEWATER TREATMENT SYSTEMS,
Tampere Univ. of Technology (Finland).
P. Rantala, and P. Vaananen.
Water Science and Technology, Vol. 17, No. 1, p 255-264, 1985. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Cost analysis, *Wastewater treatment, *Anaerobic digestion, Aerobic digestion, Reviews, Economic aspects, *Pulp and paper industry, Activated sludge process, Biogas.

The costs of different types of aerobic, anaerobic and combined wastewater treatment systems are compared. The assumed BOD or COD-loads from typical forest industry processes form the basis of comparison. General cost curves for various waste treatment processes and some case examples are also presented. It was assumed that the wastewater is treated to the same effluent quality by using activated sludge, modified activated sludge and

combination of anaerobic-aerobic treatment process. Different types of combinations are analyzed in the anaerobic-aerobic systems. The selection of the method or combination of methods must always be made case by case. In some cases the anaerobic-aerobic process combination is economically competitive. Competitiveness will increase if biogas can be used and a moderate price could be calculated for it. Activated sludge, and especially aerated lagoon processes, in some cases have a disadvantage of requiring larger treatment spaces. Poor soil conditions and long distances to lead effluent may significantly increase the cost of these aerobic treatment methods. The factors which may make anaerobic processes economically competitive are high concentrations of BOD and COD, the possibility of using biogas, the lack of suitable land in the neighborhood of the mill for treatment processes which need large areas, strict effluent standards and a high temperature of the wastewater owing to which wastewater cooling is needed prior to the aerobic processes, whereas in the anaerobic processes a thermophilic area can be used. (Baker-IVI)
W85-07018

FOREST INDUSTRY ANAEROBIC WASTEWATER TREATMENT AND ITS FUTURE DEVELOPMENT,
Ekono Oy, Helsinki (Finland).
J. Orivuori.
Water Science and Technology, Vol. 17, No. 1, p 265-270, 1985. 1 Tab, 7 Ref.

Descriptors: *Industrial wastes, *Wastewater treatment, *Pulp and paper industry, Anaerobic digestion, Reviews.

Reasons for the interest in anaerobic treatment are focused on in the light of recent developments in knowledge of the quality and quantity of forest industry wastewaters. Future wastewater characteristics and the possibility of anaerobic treatment to meet future demands are discussed. The need for cooperation between forest industry process engineers and wastewater treatment specialists is emphasized in order to optimize internal and external pollution control methods. Basic research should be carried out in the following main areas for future use: wastewater components, pure cultures of anaerobic bacteria, trace element role and need, and toxic compounds used or produced by the pulp and paper industry. (Baker-IVI)
W85-07019

ANAEROBIC TREATMENT OF SULPHITE EVAPORATOR CONDENSATE IN A PILOT PLANT OF NOVEL DESIGN,
PURAC A.B., Lund (Sweden).
L. Gunnarsson, and B. Rosen.
Water Science and Technology, Vol. 17, No. 1, p 271-279, 1985. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Wastewater treatment, *Pulp wastes, *Anaerobic digestion, *Pilot plants, *Evaporator condensate, Sulfites, Fixed bed reactor, Biological wastewater treatment, Chemical oxygen demand, Suspended solids, Sludge.

Sulfite evaporator condensate has been treated in an anaerobic pilot plant, consisting of two separate units. One unit was an ordinary mixed reactor. The second reactor was identical to the first, but is contained in addition a plastic medium as a fixed bed reactor. The agitator in the reactor provided circulation through the medium. Both reactors had internal sedimentation and no external settling device. The reactor with a fixed biofilm was more stable and had an overall better performance than the reactor without a medium. The latter was particularly severely disturbed by an instantaneous intrusion of high amounts suspended solids, which did not affect the former. Twelve weeks after the start of the tests, the fixed bed reactor was not yet in final equilibrium, but at a loading of 0.5 cu m/cu m and 6 kg COD/cu m x d, the COD-reduction was 66%, the BOD-reduction 84%, giving 68% methane in the biogas and 0.15 cu m CH4 was produced per kg COD added. The results show a positive effect of the conversion of a suspended growth system to a partially attached system. The results were not affected by the performance of the separation of sludge and water as filtered reactor content was analyzed in order to focus on the biological transformation process. The sludge in the reactor without attached growth was, at least partially, washed out when a shock load of suspended solids entered the reactor, thus demonstrating one disadvantage of the system. (Baker-IVI)
W85-07020

INFLUENCE OF SULFUR COMPOUNDS ON BIOGAS PRODUCTION FROM FOREST INDUSTRY WASTEWATER,
Tampere Univ. of Technology (Finland).
J. A. Puhakka, J. A. Rintala, and P. Vuoriranta.
Water Science and Technology, Vol. 17, No. 1, p 281-288, 1985. 3 Fig, 3 Tab, 28 Ref.

Descriptors: *Wastewater treatment, *Sulfur compounds, *Pulp and paper industry, Biogas, Anaerobic digestion, Methanogenesis, Sulfur, Evaporator condensate, Lignosulfonate.

Various inorganic sulfur compounds and lignosulfonate were studied with respect to their effect on biogas production from synthetic wastewater simulating sulfite evaporator condensate. In biogas production assay tests municipal digester sludge was used as seed material. The results show that the oxidation state of sulfur had an influence on inhibition of biogas production from the simulated evaporator condensate wastewater. Sulfate and sulfide in concentrations 100 mg S/l had no effect whereas sulfite, thiosulfate and dithionite caused a lag-period in biogas production. Inorganic sulfur compounds were partially reduced to sulfide in anaerobic conditions. (Baker-IVI)
W85-07021

ROLE OF FACULTATIVE ANAEROBIC MICRO-ORGANISMS IN ANAEROBIC BIODEGRADATION OF CHLOROPHENOLS,
Enso-Gutzeit Oy, Imatra (Finland). Research Centre.
R. Hakulinen, S. Woods, J. Ferguson, and M. Benjamin.
Water Science and Technology, Vol. 17, No. 1, p 289-301, 1985. 10 Fig, 3 Tab, 23 Ref.

Descriptors: *Microorganisms, *Anaerobic digestion, *Chlorophenols, Organic compounds, Wastewater treatment, Bacteria, Yeasts, Phenols.

A search was begun for microorganisms that might dechlorinate chlorophenols in continuous flow reactors and to isolate and identify these organisms in pure or mixed cultures. Pure cultures of facultative anaerobic bacteria and yeasts were isolated from anaerobic reactors fed synthetic wastewater which contained eight different chlorophenolic compounds. The most common species were Klebsiells spp. and K. pneumoniae. Some common colonies were identifed as Pseudomonas-like organisms and Aeromonas hydrofilia. The concentration of Pseudomonas-like organisms increased, as did the concentration of yeasts, when the total chlorophenol concentration in the feed was increased from zero to 2.4 or 5.3 mg/l. Under anaerobic conditions pure and mixed cultures were tested for use of 2,4,6-trichlorophenol (2,4,6-TCP) as a sole carbon and energy source. None of the isolates was able to degrade 2,4,6-TCP under anaerobic condition in pure cultures. Mixed cultures containing only P. aeruginosa and K. oxytoca were able to degrade 2,4,6-TCP. Microscopic observations suggest that yeasts, morphologically resembling Candida type, may play a major role in the formation of flocs in an anaerobic dechlorination reactor system. The yeasts may also play a role in chlorophenol degradation, as their number increased with an increasing chlorophenol concentration. (Baker-IVI)
W85-07022

ANAEROBIC TREATMENT OF FIBRE BOARD MILL WASTEWATER,
Technische Univ., Vienna (Austria). Inst. fuer Wasserguete und Landschaftswasserbau.
H. Kroiss, and K. Svardal.
Water Science and Technology, Vol. 17, No. 1, p 307-311, 1985. 2 Fig, 2 Tab.

Descriptors: *Anaerobic degradation, *Wastewater treatment, *Pulp and paper industry, Neutralization, Pilot plants, Water reuse.

Wastewater treatment of fiber board mill effluents has important economic considerations because of the high cost of treatment. Reuse of treated wastewater can considerably reduce wastewater discharge, provided that this does not effect product quality. The specific pollution load per ton of fiber board at an Austrian factory is in the range of 110 kg COD or 50 kg BOD5. Aerobic treatment would result in unacceptable costs. Reliable neutralization was shown to be necessary to obtain good results before the wastewater enters the reactor. Maximum removal efficiencies for the COD of 86% and for the BOD5 of 94% could be achieved in lab scale investigations at low volumetric loadings. The growth of the methanogens seems to be partially inhibitied. Semitechnical pilot investigations at the mill site have not so far resulted in stable removal efficiencies over long periods. The low BOD5 concentration of the raw wastewater resulted in a relatively high loss of biomass from the sludge solids separation step. In combination with the inhibited growth of the methanogens this results in low concentration of active biomass in the anaerobic reactor. (Baker-IVI)
W85-07023

SLUDGE REDUCTION BY IN-PLANT PROCESS MODIFICATION: NEW YORK CITY'S EXPERIENCES,
New York City Dept. of Environmental Protection, Wards Island. Div. of West Operations.
For primary bibliographic entry see Field 5E.
W85-07039

DYNAMIC OPTIMIZATION OF REGIONAL WASTEWATER TREATMENT SYSTEMS,
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
S. L. Klemetson, and W. J. Grenney.
Journal of the Water Pollution Control Federaton, Vol. 57, No. 2, p 128-134, February, 1985. 9 Fig, 2 Tab, 1 Ref.

Descriptors: *Wastewater treatment, *Optimization, *Jordan River, *Salt Lake, *Utah, Planning, Decision making, Model studies.

A wastewater treatment optimization model (WTOM) was developed to analyze regional wastewater treatment needs and evaluate the timing and capacity expansion decisions for wastewater treatment systems. The procedure consists of selecting the combination of treatment plants and treatment levels over the planning period that best meets the desired objectives at the lowest total discounted future cost. The model will not perform detailed cost analyses, but does allow the economic evaluation of a large number of treatment alternatives. The application of the WTOM in the Lower Jordan River Region along the Wasatch Mountains in Salt Lake and southern Davis Counties, Utah is described. There are eight treatment plants in Salt Lake County and one in Davis County that discharge effluent into the Jordan River in sufficient quantity to be considered for study. There was sufficient treatment capacity in the region to meet the current needs; however, three of the plants, Murray, Tri-Community, and Sandy, were overloaded. Planning of wastewater treatment systems was needed because of the population growth predicted for the region. The WTOM was able to analyze the costs of 10 alternative over a 20 year period in about 20 seconds. The time for the dynamic programming portion of the model for analyzing four alternatives over a 20 year period was about 30 seconds. The model can also perform a complete economic analysis of an individual alternative to provide information for preliminary reports. The proper timing of additions and expansions to wastewater treatment systems is critical from an economic standpoint. The problem can best be solved in the context of an optimal staging policy which allows the construction and operation of a treatment system that meets water quality standards at the lowest possible cost. (Baker-IVI)

W85-07041

BIOLOGICALLY ENHANCED OXYGEN TRANSFER IN A FIXED-FILM SYSTEM,

Washington Univ., Seattle. Dept. of Civil Engineering.
S. Reiber, and D. Stensel.

Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 135-142, February, 1985. 13 Fig, 1 Tab, 19 Ref.

Descriptors: *Biological wastewater treatment, *Oxygen transfer, *Fixed-film reactors, Biochemical oxygen demand, Dissolved oxygen, Wastewater treatment.

A measurement technique was sought to separate interfacial oxygen transfer and bulk liquid dissolution transfer rates, to investigate oxygen transfer characteristics in a sparged fixed-film system, and to determine fundamental parameters that affect interfacial oxygen transfer rates in a sparged, fixed-film system. An experimental apparatus incorporating a closed gas recycle loop and electrolytic oxygen generator provided a continuous and accurate in situ method to measure oxygen consumption in a biological reactor. Steady-state and unsteady-state oxygen consumption rates could be monitored. In a sparged, fixed-film biological reactor, interfacial transfer and bulk liquid dissolution occurred simultaneously. Oxygen dissolution to the bulk liquid was assumed to follow the conventional concept of two-film gas transfer. Interfacial oxygen transfer, on the other hand, represented an additional consumption pathway resulting from the close contact between sparge gas bubbles and an active biofilm surface. The bulk liquid dissolution rate was determined from clean water test procedures performed at each combination of sparge and hydraulic application rate. The interfacial oxygen transfer rate was determined by measuring the total system oxygen consumption rate using the CFER and then subtracting both the oxygen transfer rate caused by bulk liquid dissolution and the oxygen consumption rate from the influent liquid. (Baker-IVI)
W85-07042

OPTIMAL DESIGN OF FLUIDIZED BED BIOREACTORS,

State Univ. of New York at Buffalo. Dept. of Chemical Engineering.
G. Andrews, and R. Trapasso.

Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 143-150, February, 1985. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Fluidized bed process, *Optimization, *Bioreactors, Systems design, Biological wastewater treatment, Particle size, Support particles.

For any supported film bioreactor there exists, for a given support particle size and substrate concentration, a film thickness that maximizes the uptake rate per unit reactor volume. In choosing the support particles for best reactor performance several factors must be considered. One is solids mixing, which must in practice fall somewhere between three possible extremes: complete mixing, complete stratification based on support particle size, and with monosize support particles, stratification based on microbial film thickness. With the small particle sizes and bed porosities required for high loadings, one of these forms of stratification will usually be significant. Any design must have a Reynolds number greater than 1 to minimize the liquid-phase mass transfer resistance. Between this constraint and the extremes of solids mixing, numerous modes of operation are possible, of which two appear promising. The first involves light monosize support particles. Such particles tend to stratify with the thickest films near the base of the bed, which approximates the optimum distribution of film. The second involves heavy particles like sand. They can be smaller, which compensates for their tendency to stratify in reverse with the thinnest films near the base. (Baker-IVI)
W85-07043

INVESTIGATION OF THE REMOVAL OF ORGANICS AND NITROGEN IN AN OXIDATION DITCH,

Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang, and D. M. Drew.

Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 151-156, February, 1985. 3 Fig, 3 Tab, 26 Ref.

Descriptors: *Oxidation ditches, *Wastewater treatment, *Nitrogen, *Organic compounds, Nitrification, Denitrification, Oxidation.

Oxidation ditches, in addition to reducing short-circuiting by providing a plug-flow regime, can provide favorable conditions for simultaneous reduction of organic and nitrogenous materials. A significant process stability was illustrated by the relatively uniform final effluent quality, under substantially variable influent loading conditions. The organic substrate reaction rates of the aerobic zones were about two orders of magnitude higher than that of the post aeration zone, and about three orders of magnitude higher than those of the anoxic zones. The specific cell growth rates of the aerobic zones were similar to substrate reaction rates, about two orders of magnitude higher than that for the post aeration zone. Through the linearization of the Monod model, the maximum specific cell growth rates determined for aerobic and post aeration zones were 0.2/hr and 0.00156/hr, respectively. The bioactivity may vary considerably within an oxidation ditch, and be highest at the aerobic zones where the aerators are located. The rapid alternation between aerobic and anoxic conditions provides a natural environment for nitrification and denitrification in which total nitrogen removal results. The ammonia reaction rate and the specific cell growth rate of Nitrosomonas in the aerobic zones were two orders of magnitude higher than that in the post aeration zone. Overall treatment efficiency can be increased by adjusting the oxygenation capacity along the ditch channels. A progressive increase in dissolved oxygen is maintained from the upstream to downstream channels, providing buffering capacities for diurnal peak loadings and favorable conditions for sludge that settles well. (Baker-IVI)
W85-07044

WATER QUALITY IMPACTS OF CHLORINATING PAPERMILL EFFLUENTS,

Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Water Quality Management.
R. H. Shertzer.

Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 172-180, February, 1985. 4 Fig, 7 Tab, 18 Ref.

Descriptors: *Water quality control, *Chlorination, *Brandywine Creek, *Pennsylvania, *Pulp and paper industry, Bacteria, Klebsiella, Escherichia, Coliforms, Wastewater treatment, Effluents.

The water quality benefits and detriments of chlorinating two papermill effuents aproximately 6 km upstream from a drinking water intake in Chester County, Pennsylvania, were evaluated. Klebsiella was a major component of the fecal coliform bacteria discharged by both papermills and consistently outnumbered Escherichia coli in the effluents and at all downstream sampling stations. E. coli were dominate in the background stream collections and in the discharge from the municipal wastewater treatment plant. All samples (stream and effluent) demonstrated a trend toward lower bacteria counts during the chlorination phases of the study. Neither papermill satisfied current applicable permit requirements for coliform bacterial density with chlorination. Both Klebsiella and E. coli densities demonstrate progressive instream reductions with distance downstream from the papermills. This pattern, attributable to dilution, die-off, or settling, was not altered by chlorination, indicating limited carry over of chlorine or chlorine compounds into East Branch Brandywine Creek and little or no regrowth of bacteria instream. An evaluation of instream water quality showed that conditions were fairly constant during chlorination and nonchlorination phases of the study. Stream biology was not altered by chlorine addition. Macroinvertebrate collections made above and below the papermills showed virtually no change after chlorination and characterized the stream as a warm water habitat receiving organic or oxygen-demanding waste which caused slight to moderate degradation. No toxic response from either chlorine or heavy metals and no adverse impact on protected recreational water uses was detected. (Baker-IVI)
W85-07047

OVERLAND FLOW WASTEWATER TREATMENT AT EASLEY, SOUTH CAROLINA,

Clemson Univ., SC. Dept. of Environmental Systems Engineering.
A. R. Abernathy, J. Zirschky, and M. B. Borup.

Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 291-299, April, 1985. 4 Fig, 11 Tab, 12 Ref.

Descriptors: *Overland flow, *Wastewater treatment, *Performance evaluation, *Easley, *South Carolina, Ammonia, Biochemical oxygen demand, Total organic corbon, Suspended solids, Nitrogen, Model studies, Kinetics.

Data was collected from the Easley, South Carolina overland flow treatment system to develop kinetic rate constants for describing pollutant removal during overland flow. These constants are compared with similar constants in the literature. The performance data show the process to be efficient and cost-effective. Pollutant removals from wastewater as it flows down the overland flow slopes followed first-order kinetics. The kinetic rate constants developed from the Easley data generally differed significantly from similar constants in the literature. Differences in the characteristics of the Easley system and the systems from which the other models were developed could account for the poor performance of these models. When the UCD model was modified to account for a different residual TOC concentration, however, it accurately predicted BOD and TOC removal at the Easley system (with the exception of BOD removal at the 0.21 cubic m/hr application rate). Agreement between the CRREL Method and the Easley data was also limited. Although both the UCD model and the CRREL Method successfully modeled pollutant removal on the systems in which these models were developed, these models should be verified further with data from other overland flow systems. The UCD models should, perhaps, be modified to account for residual pollutant concentrations which may differ from those used to develop the model. (Baker-IVI)
W85-07050

SIMULTANEOUS DENITRIFICATION WITH NITRIFICATION IN SINGLE-CHANNEL OXIDATION DITCHES,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, and W. E. Langeland.

Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 300-308, April, 1985. 4 Fig, 9 Tab, 39 Ref.

Descriptors: *Denitrification, *Oxidation ditches, *Nitrification, Chemical oxygen demand, Nitrogen, Wastewater treatment, Performance evaluation, Oxygen.

Successful one-reactor denitrification with nitrification was documented at two full-scale single-channel oxidation ditches. Nitrogen loss and reduction in required oxygen were demonstrated through mass balances. Sampling of dissolved oxygen and NO2(-) + NO3(-)-N, as well as theoretical considerations, indicated that denitrification occurred continuously in anoxic microzones inside the floc. Anoxic zones within the reactor were not necessary and were never detected at one of the facilities. Operation of one-reactor denitrification with nitrification in an oxidation ditch was relatively simple. The primary control parameter was the oxygen transfer rate, which was sufficient to transfer enough oxygen to satisfy nitrification and aerobic COD oxidation and maintain a suitable dissolved oxygen concentration. Average concentrations between 0.1 and 0.5 mg/L oxygen were successful at the two field sites. (Baker-IVI)

W85-07051

RATIONAL DESIGN PARAMETERS FOR AMMONIA CONVERSION IN WATER HYACINTH TREATMENT SYSTEMS,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
A. S. Weber, and G. Tchobanoglous.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 316-323, April, 1985. 10 Fig, 5 Tab, 11 Ref.

Descriptors: *Water hyacinth, *Wastewater treatment, *Ammonia, Design criteria, Plug flow reactors, Aquatic plants, Hydraulic properties.

Parameters currently used to design (size) aquatic systems include hydraulic detention time, hydraulic loading rate, hydraulic applicaton rate, and nitrogen loading rate. A series of pilot scale plug flow water hyacinth reactors were operated under a variety of experimental conditions to determine rational design parameters for NH4(+)-N conversion. Ammonium nitrogen conversion in plug flow water hyacinth systems is a function of the hydraulic application rate and reactor length. Ammonium nitrogen conversion rate is independent of the NH4(+)-N loading rate. The use of hydraulic detention time as a design parameter is not recommended. (Baker-IVI)
W85-07052

KINETIC STUDIES OF CHEMICAL AND BIOLOGICAL TREATMENT FOR RENOVATION,
Technion - Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
M. Rebhun, N. Galil, and N. Narkis.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 324-331, April, 1985. 12 Fig, 6 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Wastewater renovation, *Kinetics, Biological wastewater treatment, Chemical treatment, Lime, Acidity, Nitrification, Denitrification, Sludge treatment.

A comparison was made of the substrate removal and growth rate constants, and die-off rate and yield coefficients of chemically treated and conventionally settled wastewater from the same source. Alum chemically flocculated wastewater (CFW) can be biologically treated in all modes of operation; the high-pH lime CFW can be treated in the nitrification and combined nitrification-denitrification modes, because of the acidity generated in nitrification that reduces the high pH. The CFW contains only soluble BOD (substrate) to be removed by biodegradation and biosynthesis; the settled wastewater (SW) contains the same soluble BOD and also particulate BOD to be removed by biodegradation and by agglomeration in the biofloc. Expressions were developed to distinguish and calculate the rate of removal by biodegradation as part of total removal rate and the biomass yield coefficient as a part of total sludge yield coefficient. The substrate removal rate constants, the growth rate constants, and the yield coefficients were considerably higher for CFW than for SW. The growth rate of nitrifiers of CFW was much higher than for SW; the critical sludge age for nitrification of CFW was 4 days, as compared to 10 days for SW. The soluble organic substrate (soluble BOD) in SW and in CFW was readily available as a carbon source for denitrification, whereas the particulate BOD was not available in the denitrification reactors at residence times of 1 to 2 hours. (Baker-IVI)
W85-07053

STUDY OF THE BIODEGRADABILITY OF RESIDUAL COD,
A. F. Gaudy, and T. R. Blachly.
Journal of the Water Pollution Control Federation, Vol. 57, No. 4, p 332-338, April, 1985. 9 Fig, 1 Tab, 15 Ref.

Descriptors: *Chemical oxygen demand, *Aerobic treatment, *Biodegradation, Continuous flow processes, Wastewater treatment, Oxygen demand.

Biological treatment for removal of soluble waste organic substrates has proven highly successful, but treatment efficiency is seldom 100%. Residual organic material remains even when simple monosaccharides or organic acids are fed to an acclimated microbial population under ideal aerobic growth conditions. The long term fate of the COD remaining after aerobic treatment of a synthetic waste was explored. The major conclusion is that while the residual COD measured in batch or continuous-flow treatability studies is nonbiodegradable, for practical purposes, in secondary treatment processes, it can be metabolized over the long term. More than 90% of this residual is subject to biological metabolism. Long cell retention times correspond to slow specific growth rates. This work indicates that slow specific growth rates make for lower specific decay rates, but it seems that an equilibrium value is approached. (Baker-IVI)
W85-07054

CANMET'S PROJECT ON THE CHEMISTRY, GENERATION AND TREATMENT OF THIOSALTS IN MILLING EFFLUENTS,
Noranda Research Centre, Pointe Claire (Quebec).
M. Wasserlauf, and J. E. Dutrizac.
Canadian Metallurgical Quarterly, Vol. 23, No. 3, p 259-269, July-September, 1984. 2 Fig, 3 Tab, 41 Ref.

Descriptors: *Thiosalts, *Sulfide ore milling, *Wastewater treatment, *Wastewater analysis, Effluents, Costs, Biological wastewater treatment, Sample preservation, Titration.

During the milling of sulfide ores, part of the sulfide content is oxidized by oxygen dissolved in processing streams. Although the thermodynamics of the oxidation process suggest that only sulfate should be produced, kinetic limitations in neutral or alkaline media result in the formation of partially oxidized sulfur oxyanions, collectively known as thiosalts. Thiosalt-containing effluents are unstable at ambient temperatures. Methods of storing and analyzing thiosalt effluents were developed. The Noranda mercuric chloride titration procedure is both simple and accurate. Both in-mill and laboratory studies were conducted to evaluate the factors governing the generation of thiosalts during milling. The principal factors affecting thiosalt generation in milling circuits were grinding pH, sulfide content of the ore, residence time and temperature. Mass balances were conducted at two operating mills to define the relative importance of the various unit operations. Fourteen methods of thiosalt destruction were evaluated on technical and economic grounds. Although most of these methods were evaluated in bench scale tests or in preliminary studies, pilot scale on-site tests were conducted to determine the feasibility of biological oxidation. Considering all aspects of the treatment, thiosalt destruction costs are very high. None of the methods has been demonstrated to be continuously effective for the large scale treatment of actual thiosalt effluents. (Moore-IVI)
W85-07091

RECOVERY OF ACID FROM WASTEWATER BY ELECTRODIALYSIS,
Yokohama National Univ. (Japan).
K. Urano, T. Ase, and Y. Naito.
Desalination, Vol. 51, No. 2, p 213-226, August, 1984. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Chemical recovery, *Electrodialysis, *Wastewater treatment, Membrane processes, Iron and steel industry, Acid recovery.

Acidic wastewater which is released from the iron and steel industry is one of the wastewaters that needs the application of techniques which not only can remove pollutants but also can recover valuable materials from wastewater. The optimum operating conditions for electrodialysis using a newly developed membrane were studied for recovery of acid from acidic wastewater released from the iron and steel industry. Equations are given to express the limiting current densities and the current efficiencies. The concentration of iron(III) ion should be controlled lower than one twentythird of the acid concentration of diluting solution since the electric resistance of the cation exchange membrane was increased considerably by fouling with iron(III) ion. Calculations for the plant design and the cost estimate were attempted from the experimental results obtained. (Baker-IVI)
W85-07095

REMOVAL OF HEAVY METALS FROM WASTEWATER BY APPLICATION OF HOT IRON DESULFURIZATION SLAG,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
G. S. Lee, and J. J. Ganczarczyk.
Asian Environment, Vol. 6, No. 4, p 17-20, 1984. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Heavy metals, *Desulfurizing slag, Iron, Phenols, Economic factors, Sulfides, Precipitates.

Desulfurizing slag proved advantageous for the removal of soluble heavy metals from wastewater both technically and economically. This process was superior to hydroxide precipitation as well as sulfide precipitation in the sense that it remained effective over a wider range of pH. A steady stream of good quality effluent could be produced with less attendance. This process eliminated chemical costs that are associated with sulfide precipitation and hydroxide precipitation. Low residual dissolved zinc of not more than 0.2 mg/l can be achieved over a pH range of 9.0 to 10.9. The main removal mechanism was believed to be a combination of sulfide precipitation and hydroxide precipitation. Other mechanisms like adsorption could also have contributed. Dissolved sulfide was introduced into the wastewater by the desulfurizing slag but only in very small amounts which was not likely to cause any pollution problems. Phenol removal was an added advantage of slag; phenols were totally eliminated from the blast furnace blowdown from an initial concentration of 29.44 micro-g/l by using 8 micro-g/l of desulfurizing slag. (Baker-IVI)
W85-07108

EFFECT OF THE RATIO OF REACTOR DIAMETER TO PARTICLE SIZE ON THE PERFORMANCE OF A MOVING MEDIA REACTOR,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. J. Bhatt, D. S. Bhargava, and P. S. Panesar.
Asian Environment, Vol. 6, No. 4, p 21-23, 1984. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Phenols, *Reactor size, *Particle size, Diffusion, Adsorption, Organic compounds, Moving media reactor.

The effect of reactor size on phenol removal was investigated. The ratio of equilibrium concentration attained in the effluent sample (C) to the initial influent concentration of phenol (Co), that is (C/Co), is observed to increase with an increase in ratio of sorbent to sorbate mass input rates (Ws/WL). At lower values of Ws/WL the rate of reduction in C/Co is faster compared to the higher values of Ws/WL. A Ws/WL ratio of .015 to .02 is observed to be optimum giving C/Co values in the range of 0.45 to 0.6 (that is, removal of 40 to 55%). The variation in values of C/Co is also observed to be dependent upon the ratio of reactor diameter to charcoal particle diameter (D/dm). A charcoal particle having diameter 280 micron giving a D/dm ratio of 402.8 is found to be optimum giving a C/Co value of 0.45 (that is, 55% removal) at an optimum value of Ws/WL = .02. The variation in phenol removal efficiency, in microgram per gram of charcoal (qe) decreases with an increase in ratio of sorbent to sorbate mass input rates (Ws/WL). At lower values of Ws/WL variation in qe is sensitive and significant while at higher values of Ws/WL the variation in qe values is not so significant. The variation in qe values is also dependent on the ratio of the diameter of reactor to diameter of the sorbent particle (D/dm). A charcoal particle size of 280 micron giving a D/dm ratio of 402.8 is optimum giving maximum qe values of 300 micrograms of phenol removed/gram charcoal at an optimum Ws/WL ratio of .02. The Reynolds

Number and the terminal settling velocity for the charcoal particle govern the overall removal for a given D/dm and Ws/WL ratios. (Baker-IVI)
W85-07109

BIOLOGICAL WASTEWATER TREATMENT IN A FLUIDIZED BED REACTOR,
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
T. Akiyama, I. Tanaka, M. Koga, H. Hori, and M. Yano.
Asian Environment, Vol. 6, No. 4, p 24-26, 1984. 5 Fig, 2 Tab, 5 Ref.

Descriptors: *Biological wastewater treatment, *Fluidized bed process, Total suspended solids, Dissolved oxygen, Suspended solids, Wastewater treatment, Organic carbon.

A biological fluidized bed process has several important advantages due to the high concentration of biomass that can be maintained in the bed. The major advantages are reduction of construction cost, energy and space requirements. Basic data obtained experimentally by using the laboratory scale reactor for the optimum design in a biological fluidized bed treatment to primary-treated domestic sewage are presented. Measurements of conventional parameters were started after the TOC removal efficiency was indicated to be above 80%. TOC removal efficiency slightly increased with decreasing sand diameters. TOC removal rate was proportional to TOC loading rate. The local VSS (volatile suspended solids) concentration was varied along the bed height in the fluidized bed, that is, a few in the lower region, maximum in the middle and decreasing numbers with height in the upper region. DO and TSS concentration decreasd with the bed height. The effuent BOD5 concentration exceeded 20 mg/l, when the BOD5 load rate was 7 kg/cubic m day. This value was similar to that in the previous reports. The average VSS was 11 g/l in the biological fluidized bed treatment and the value was several times larger than the conventional activated sludge treatment. (Baker-IVI)
W85-07110

MODEL SYSTEM OF BULKING AND FLOCCULATION IN MIXED CULTURE OF SPHAEROTILUS SP. AND PSEUDOMONAS SP. FOR DISSOLVED OXYGEN DEFICIENCY AND HIGH LOADING,
Osaka Univ. (Japan). Dept. of Biochemical Engineering.
H. Tanaka, N. Kurano, S. Ueda, S. Ueda, and M. Okazaki.
Water Research, Vol. 19, No. 5, p 563-571, 1985. 13 Fig, 3 Tab, 20 Ref.

Descriptors: *Activated sludge processes, *Bulking sludge, *Flocculation, *Dissolved oxygen, Organic loading, Sedimentation, Bacteria.

A mixed continuous culture system was made up as a model for bulking and flocculation phenomena of the activated sludge to study the effect of dissolved oxygen deficiency and the effect of high organic loading. The system consisted of a floc forming bacterium and a filamentous bacterium which were isolated from the activated sludge and were identified as Pseudomonas sp. and Sphaerotilus sp., respectively. Sphaerotilus sp. had the potential to cause a filamentous bulking phenomenon on the activated sludge. In the sample activated sludge, a slight reduction of dissolved oxygen (DO) level in the reactor induced filamentous bulking gradually, while a further reduction of DO level caused it more rapidly. In this bulking sludge, the respiration activity has increased, but the affinity for oxygen is constant. In the case of this filamentous bulking owing to DO deficiency, the maximum oxygen uptake rate may depend on the change of microflora. The filamentous bulking in the sample sludge is caused by addition of the filamentous bacterium. On the contrary, the mixed culture of the filamentous and the floc forming bacteria has good settling characteristics compared to the pure cultures of each strain. Therefore the change of DO level gives rise to the transformation of growth figures of both strains. (Baker-IVI)
W85-07115

INFLUENCE OF PROCESS VARIABLES ON THE MODELLING AND DESIGN OF A ROTATING BIOLOGICAL SURFACE,
Genoa Univ. (Italy). Ist. di Scienze e Tecnologie dell'Ingegneria Chemica.
M. Del Borghi, E. Palazzi, F. Parisi, and G. Ferraiolo.
Water Research, Vol. 19, No. 5, p 573-580, 1985. 8 Fig, 4 Tab, 29 Ref.

Descriptors: *Biochemical oxygen demand, *Rotating biological surface, Model studies, Design criteria, Temperature effects, Wastewater treatment, Biological wastewater treatment, Industrial wastewater.

The Rotating Biological Surface (RBS) process variables were investigated to determine the efficiency of BOD5 removal from wastewater. Operating parameters including influent substrate concentration, liquid retention time, stage temperature, flow rate, disk surface area, hydraulic loading, disk rotational speed, disk sizes, number of disks, fractional submergence, were evaluated. The process parameters were obtained from a pilot scale RBS plant constructed and applied to the treatment of municipal and industrial wastewater and from the literature. The data were employed to determine a kinetic equation of general application which tends to the well-known Michaelis-Menten equation for municipal wastewater and easily degradable substrates. The hydraulic loading, stage number and wastewater temperature are the most significant variables affecting the RBS system performance. The presently developed RBS model shows higher accuracy in predicting the effectiveness of percent BOD removal than Wu's model. The obtained model for urban wastewaters cannot be applied to high strength industrial wastewaters where poorly biodegradable substrates are present together with easily degradable substrates. The situation has been verified by treating strawpaper and tannery wastewaters. For those substrates a more complex equation has been obtained that becomes the Michaelis-Menten type equation at high values of a BOD fraction in the effluent. (Baker-IVI)
W85-07116

DENITRIFICATION BY PACKED BED REACTORS IN THE PRESENCE OF CHROMIUM(VI); RESISTANCE TO INHIBITION,
Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
Z. Lewandowski.
Water Research, Vol. 19, No. 5, p 589-596, 1985. 6 Fig, 3 Tab, 11 Ref.

Descriptors: *Chromium, *Denitrification, *Wastewater treatment, *Packed bed reactors, Filters, Inhibition, Bacteria.

Chromium salts are soluble and toxic for aquatic organisms, especially salts of Cr(6+). The effect of Cr(6+) on bacterial denitrification was investigated in packed bed reactors. Despite the long operation time of the packed bed reactors no adaptation of bacterial systems to the presence of chromium Cr(6+) was observed. The packed bed reactors supplied with various organic compounds as the electron donors for microorganisms and operated under identical conditions showed different reactor resistance to inhibition, RRI. The reactor resistance to inhibition defined as the initial concentration of inhibitor at which the obtained results in terms of the process efficiency are deteriorated may be explained. The reason for this is the difference between the time needed for the process performance and the detention time. The excess detention time over that required leads to existence of reserve in reaction rate which may be reduced by inhibitor action without deterioration of the obtained results. The biological reactors can be designed with the determined reactor resistance to inhibition RRI, according to the expected inhibitor concentration. Inhibition coefficient measurement seems to be a good tool for the inhibitor action assessment. The introduced parameters of specific inhibition sensitivity and specific resistance to inhibition seem to be convenient to characterize the bacterial system being inhibited. (Baker-IVI)
W85-07118

CHARACTERIZATION AND TREATMENT OF CONDENSATES FROM HIGH EFFICIENCY APPLIANCES,
Iowa State Univ., Ames. Dept. of Civil Engineering.
D. E. Harrold, and E. R. Baumann.
Water Research, Vol. 19, No. 5, p 627-638, 1985. 2 Fig, 6 Tab, 39 Ref.

Descriptors: *Heaters, *Condensates, *Wastewater treatment, Neutralization, Flue gases, Metals, Acidity, Sulfur compounds, Nitrogen, Nitrates, Sulfates, Limestone.

High efficiency heating equipment recovers additional heat from the combustion of fossil fuels by using heat exchangers to cool the flue gases formed in the combustion process. In order to characterize the condensate waste stream from experimental high efficiency heaters and a pulse combustion furnace, samples were analyzed for total solids, pH, acidity, alkalinity, nitrate, nitrite, sulfate and selected metals, and were screened for semivolatile organic priority pollutants including phenols and polynuclear aromatic hydrocarbons. Inorganic constituents likely to be found in the condensates were nitrite, nitrate and sulfate which form mineral acids in aqueous solution and account for the acidity and corrosiveness of condensates from gas-fired appliances. Components of condensates with the greatest potential for causing adverse effects and being environmentally unacceptable in soil or residential wastewater systems are pH and metals. Typically, pH values of 3-4 can be expected for condensates produced by high efficiency natural gas appliances. Organic priority pollutants were not detected in condensates from high efficiency natural gas-fired furnaces. Levels of copper in condensates from the experimental heaters indicate significant corrosion of the heat exchanges. Neutralization can be accomplished by passing condensate through a limestone-filled column connected to condensate drain lines, within or adjacent to the appliance, followed by disposal to a residential wastewater system, or by percolation of condensate through limestone used as the porous media in a soil absorption system. (Baker-IVI)
W85-07121

TWO-PHASE ANAEROBIC TREATMENT KINETICS OF PALM OIL WASTES,
National Univ. of Singapore. Dept. of Civil Engineering.
W. J. Ng, K. K. Wong, and K. K. Chin.
Water Research, Vol. 19, No. 5, p 667-669, 1985. 4 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Anaerobic digestion, *Palm oil wastes, Kinetics, Hydraulic retention times.

Palm oil mill effluent (POME) is a major agro-industrial waste in the Southeast Asian region. A laboratory scale two-phase anaerobic digestion system was used to treat a POME containing around 63,000 mg/l COD. Phase separation was accomplished through control of the hydraulic retention times of two reactors operated in series. Acid and methane phase biokinetic coefficients were evaluated. Steady state parameters indicate good process stability with high gas yields. The results indicate that phase separation could be achieved by manipulating the retention times of the reactors and that POME can be effectively treated with a two-phase anaerobic fermentation system. Treatment efficiency reached 85% with the (1 + 30) day system with no cell recycle. The significantly shorter minimum cell regeneration time of the two phase system should be of interest since reactor volumes can be thus reduced. (Baker-IVI)
W85-07124

INHIBITION COEFFICIENT (KI) DETERMINATION IN ACTIVATED SLUDGE,
Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
Z. Lewandowski, K. Janta, and J. Mazierski.
Water Research, Vol. 19, No. 5, p 671-674, 1985. 5 Fig, 5 Ref.

Descriptors: *Activated sludge process, *Inhibitors, Biological wastewater treatment, Chromium, Cyanide, Pesticides, Organic compounds, Wastewater treatment, Enzymes.

In biological reactors for wastewater treatment there exist many various microorganisms producing many enzymes inhibited in different ways by the toxic compounds. The observed effect is the total influence of the toxic compounds on the biological system rather than the pure inhibition of a single enzyme. The possibility of determining the inhibition coefficient Ki in activated sludge systems by means of respiration rate measurements by the application of a dissolved oxygen matter have been proven. The measured values of Ki were equal to: 87 mg/l of chromium Cr(6+); 0.293 mg/l of cyanide CN(-); 2220 mg/l of DDVP; and 13,800 mg/l of des-methyl DDVP. The applied method of measurement of the inhibition coefficient is simple and time saving. (Baker-IVI)
W85-07125

BIOTRANSFORMATION OF TETRACHLOROETHYLENE TO TRICHLOROETHYLENE, DICHLOROETHYLENE, VINYL CHLORIDE, AND CARBON DIOXIDE UNDER METHANOGENIC CONDITIONS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-07127

GROWTH CHARACTERISTICS OF AQUATIC MACROPHYTES CULTURED IN NUTRIENT-ENRICHED WATER: II. AZOLLA, DUCKWEED, AND SALVINIA,
Central Florida Research and Education Center, Sanford, FL.
K. R. Reddy, and W. F. DeBusk.
Economic Botany, Vol. 39, No. 2, p 200-208, April-June, 1985. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Azolla, *Duckweed, *Salvinia, *Plant growth, *Biomass, Florida, Aquatic plants, Macrophytes, Nitrogen, Phosphorus, Seasonal variation, Floating plants.

The success of aquatic macrophyte-based wastewater treatment systems depends on rapid year-round plant growth and nutrient uptake. The seasonal growth characteristics and biomass yield potential of 4 small-leaf, floating, aquatic macrophytes cultured in nutrient nonlimiting conditions were studied under central Florida's climatic conditions. Biomass yields were 10.6, 11.3, 16.1, and 32.1 t (dry wt)/ha/yr, respectively, for azolla (Azolla caroliniana), giant duckweed (Spirodela polyrhiza), common duckweed (Lemna minor), and salvinia (Salvinia rotundifolia). Operational plant density was in the range of 10-80 g dry wt/sq m for azolla, 10-88 g dry wt/sq m for giant duckweed, 10-120 g dry wt/sq m for common duckweed, and 35-240 g dry wt/sq m for salvinia. Specific growth rate (% increase per day) was maximum at low plant densities and decreased as the plant density increased. Although small-leaf, floating plants may not be suitable in monoculture biomass production systems because of low biomass yields, they may be suitable for inclusion in polyculture systems with larger aquatic plants. The high N content (crude protein = 20-33%) of small-leaf, floating plants suggests the use of biomass as animal feed. Overall N and P removal by these plants is low compared to many large-leaf, floating plants, but the narrow N/P ratio suggests that these plants are efficient in removing P from wastewaters. (Moore-IVI)
W85-07144

5E. Ultimate Disposal Of Wastes

FEASIBILITY OF USING FOREST VEGETATION TO RENOVATE SEPTIC TANK EFFLUENT IN THE NEW JERSEY PINE BARRENS,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
For primary bibliographic entry see Field 5D.
W85-06310

REGULATING HAZARDOUS AND MIXED WASTE AT DEPARTMENT OF ENERGY NUCLEAR WEAPONS FACILITIES; REVERSING DECADES OF ENVIRONMENTAL NEGLECT,
Natural Resources Defense Council, Inc., Washington, DC.
For primary bibliographic entry see Field 6E.
W85-06528

MULTI-OBJECTIVE OPTIMIZATION MODEL FOR AQUIFER MANAGEMENT UNDER TRANSIENT AND STEADY-STATE CONDITIONS,
Nebraska Univ., Lincoln. Dept. of Mathematics.
For primary bibliographic entry see Field 4B.
W85-06562

USE OF THE CONVEYANCE METHOD IN DESIGN AND ANALYSIS OF PRESSURIZED EFFLUENT DISTRIBUTION SYSTEMS,
P. Vosse.
Journal of Environmental Health, Vol. 47, No. 4, p 180-183, January/February, 1985. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Effluent distribution systems, *Pressurized systems, *Conveyance method, Wastewater disposal, On-site wastewater disposal, Mathematical equations, Hydraulic design.

The trend in on-site sewage disposal systems to large distribution fields, mounds and filter beds has resulted in the increased use of pressurized effluent distribution systems to obtain equal application. The design of such systems has been complicated by the need to determine the sum of pressure losses between each discharge orifice and each manifold outlet, a process requiring several iterations of complicated equations. The Conveyance Method simplifies the design of pressurized distribution systems by providing an equation to calculate the total pressure loss in such a pipe in one step. A procedure is presented for designing a pressurized effluent distribution system using the Conveyance Method to determine pressure balance in the system. The procedure includes the determination of the spacing discharge orifices and the sizing of the effluent pump and pump chamber. The purpose of a pressurized system is to provide equal distribution of the sewage effluent throughout the drainfield piping. This will occur if there is equal flow in each lateral, equal flow from each orifice, and the orifices are equally spaced within the lateral. The flow within the system is controlled by the orifice diameter and the hydraulic pressure. Application of the conveyance method is demonstrated by an example. The steps in the procedure call for determining orifice flow, orifice spacing and total system flow, headloss calculations, percent difference in orifice pressure, and completion of the hydraulic design by determining the total required pump head. (Baker-IVI)
W85-06608

EFFECT OF SLUDGE APPLICATION OF PHYSICAL PROPERTIES OF A SILTY CLAY LOAM SOIL,
Wisconsin Univ.-Madison. Dept. of Soil Science.
Q. F. Wei, B. Lowery, and A. E. Peterson.
Journal of Environmental Quality, Vol. 14, No. 2, p 178-180, April/June, 1985. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Land treatment, *Soil types, *Soil properties, *Sludge disposal, Sludge utilization, Bulk, Infiltration, Permeability coefficient, Aggregate stability.

The long-term effect of dewatered sludge application was studied on a silty clay loam soil, which possesses poor permeability and other undesirable properties. A Zimpro-processed dewatered sludge was applied in early 1977 at treatment rates of 0, 11.2, 22.4, 44.8, and 112.0 Mg/ha (dry solids basis) to a Kewaunee silty clay loam soil (Typic Hapludalf). A sixth treatment was an annual application of 22.4 Mg/ha from 1977 to 1982, resulting in a total input of 134.4 Mg/ha. Bulk density, infiltration, hydraulic conductivity, and aggregate stability were measured 5 yr after application (note: fifth year of annual sludge application at 22.4 Mg/ha). The bulk density decreased by 0, 0.7, 3.5, 8.3, and 6.3% over the control for the 11.2, 22.4, 44.8, 112.0, and 134.4 Mg/ha of sludge treatment, respectively. The hydraulic conductivities of saturated soil cores were 0, 4.2, 45.4, 70.2, and 70.6% higher for the 11.2, 22.4, 44.8, 112.0, and 134.4 Mg/ha sludge treatment, respectively, over the control. The improved soil permeability was due to the enhancement of aggregate stability, which increased relative to the control by 3.3, 9.4, and 11.9% with the 44.8, 112.0, and 134.4 Mg/ha treatment, respectively. The in situ volumetric moisture content of the sludge-treated soils was always higher than control, especially after a prolonged period of evaporation. At 33.3 kPa or less, more water was released from soils or less, treated with high rates of sludges. This indicated an increase in the volume of larger pores, which resulted in the higher hydraulic conductivities. Lower rates of sludge treatments (11.2 and 22.4 Mg/ha) had no effects on the soil physical properties after 5 yr. Small yearly applications improved the soil physical properties equally as well as a single large application. (Author's abstract)
W85-06715

REACTION OF FERTILIZER AND LIQUID MANURE PHOSPHORUS WITH SOIL AGGREGATES AND SEDIMENT PHOSPHORUS ENRICHMENT,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
V. K. Bhatnagar, M. H. Miller, and J. W. Ketcheson.
Journal of Environmental Quality, Vol. 14, No. 2, p 246-251, April/June, 1985. 5 Fig, 5 Tab, 24 Ref.

Descriptors: *Fertilizers, *Liquid manure, *Phosphorus, *Soil aggregates, *Sediments, *Agricultural runoff, No-till management, Land management, Liquid wastes, Manure, Farm wastes, Adsorption, Soil properties, Potassium.

Phosphorus enrichment ratios (PER) were estimated for sediment from six runoff events from plots that had been under one of three management systems for at least 5 yr: no-till (NT), no-till manured (NTM), and fall plowed manured (FPM). Sodium bicarbonate-extractable P enrichment ratios (Ext-PER) sediments were 2.15, 1.30, and 1.10 for NT, NTM, and FPM treatments, respectively. The higher Ext-PER on the NT treatment could not be explained solely by a higher clay enrichment. A laboratory experiment was conducted to test three hypotheses developed to explain the difference in Ext-PER values. Phosphorus in the form of either inorganic salt (KH_2PO_4) or liquid poultry manure (Chicken, Gallus gallus domesticus) was added to soil at rates up to 400 mg P/kg. Soils were passed through 7-d wetting and drying cycles for 235 d and sampled periodically. Most of the added P from both the manure and inorganic P treatment was associated with the clay fraction. The proportion of P that was desorbable increased as the amount of P added increased. This may, in part, explain the lower Ext-PER on the manured plots, which had a greater amount of P added. Manure increased water stability of soil aggregates. In addition, the Ext-P concentration in water-stable aggregates from the manure treatment increased with increasing aggregate size, whereas the inorganic P source had no effect. Manure did not alter the size distribution of dry-sieved aggregates, but Ext-P was increased to a greater extent in the larger aggregates, indicating that there was a preferential sorption of manure P by larger-sized aggregates. This conclusion was supported by results from a small field trial. The preferential sorption of P from liquid manure by larger, more stable aggregates may result in a lower Ext-PER in sediment from manured fields. (Author's abstract)
W85-06722

LONG-TERM PHOSPHORUS SORPTION IN A BRUNISOL IN RESPONSE TO DOSED-EFFLUENT LOADING,
British Columbia Ministry of Environment, Victoria.
N. K. Nagpal.
Journal of Environmental Quality, Vol. 14, No. 2, p 280-285, April/June, 1985. 3 Fig, 6 Tab, 23 Ref.

Descriptors: *Phosphorus, *Sorption, *Brunisol, *Septic wastewater, *Nutrients, Soil types, Leachate, Soil properties, Groundwater contamination, Fate of pollutants, Percolation.

Phosphorus sorption characteristics of a major soil in the Shawnigan Lake area of Vancouver Island were studied in response to periodic secondary effluent loading. Five soil columns 0.60 m long and 0.139 m in diam were prepared from the B horizon of the Shawnigan gravelly silt loam (classified as a Dystric Brunisol and Typic Dystrochrept according to the Canadian and U.S. Systems of soil classification, respectively). Water table level was maintained at the base of the two partially saturated columns (PSC). The other three columns (USC) remained unsaturated at all times and were subjected to a tension of 6.0 kPa. A single, daily dose of 1 L (approximately 6.6 cm) of secondary effluent was applied to all columns except on weekends and holidays. The effluent P was retained effectively by the USC columns initially, but broke through with time as in case of the PSC columns. The leachate P concentration reached an equilibrium value (EPC) after about 70 pore volumes of effluent had passed through the columns. The EPC changed only slightly beyond 70 pore volumes, but was a function of effluent P concentration and percolation rate. About 60 to 90% of added P was retained by the columns, even after 2.7 yr of leaching. Surface layers were the most effective renovators of effluent P; however, the total amount of P retained by the soil was dependent more on effluent percolation rate and leaching period, and less on water table level. (Author's abstract)
W85-06726

EFFECT OF SEWAGE SLUDGE ON MOBILIZATION OF SURFACE-APPLIED CALCIUM IN A GREENVILLE SOIL,
Georgia Univ., Athens. Dept. of Agronomy.
K. H. Tan, J. H. Edwards, and O. L. Bennett.
Soil Science, Vol. 139, No. 3, p 262-269, March, 1985. 1 Fig, 5 Tab, 30 Ref.

Descriptors: *Land application, *Sludge disposal, *Calcium, *Soil properties, Leaching, Potassium, Calcium, Magnesium, Aluminum, Iron, Zinc, Cadmium, Hydrogen ion concentration.

The effect of sewage sludge on movement of surface-applied Ca was determined with controlled leaching studies in the laboratory. Soil columns were prepared by filling 5.5- by 30-cm PVC plastic tubes with samples of the Ap horizon of a Greenville soil (clayey, kaolinitic, thermic Rhodic Paleudult). These were affixed to the 5.5- by 30- cm tubes filled with Bt1 horizon samples, so that the total column was 60 cm long. The soil columns, receiving various lime and sewage sludge treatments were leached with distilled water at a flow rate of 40 ml/h until 2 L of leachates was collected. The leachates were analyzed for K, Ca, Mg, Al, Fe, Zn, and Cd concentrations. After leaching, the soil columns were sectioned into four 15-cm layers for determination of pH and the above elements. Although amounts equivalent to 4.5 metric tons (t) CaCO3 and 112 t sewage sludge per ha were applied, no differences were detected in Ca contents of the leachates from soils with or without sewage sludge. Very low levels of K and Mg and negligible amounts of Al, Fe, Zn and Cd were also found in the leachates, indicating minor leaching losses of these elements. The soil apparently served as a sink for the Ca and other metals ions investigated, which is in agreement with many of the earlier published results. The present result compared favorably with results of long-term experiments, indicating that significant Ca translocation can also be achieved in a shorter term even though most of the Ca was retained in the surface section of the soil columns. A sharp decrease in extractable Ca was noted from 13.9 mmol/kg at 15 to 30 cm deep to 2.04 mmol/kg at 30 to 40 cm deep in the soil columns without sewage sludge. The bottom sections of the sludge-amended columns contained more Ca than the top sections or the original, nontreated, Ap and Bt1 horizon samples. Calcium movement into the subsoil increased soil pH. Infrared analysis indicated that mobilization of Ca was facilitated by formation of Ca-chelates, formed by the interaction of lime and fulvic acid produced by sewage sludge. Being a cation, Ca(2+) would, otherwise, be subjected to cation exchange reaction and would not be free to move down with the percolating water. (Author's abstract)
W85-06748

DEGRADATION OF PESTICIDES IN CONTROLLED WATER-SOIL SYSTEMS,
Ames Lab., IA.
G. A. Junk, J. J. Richard, and P. A. Dahm.
ACS Symposium Series, Vol. 259, p 37-67, 1984. 17 Fig, 2 Tab, 42 Ref.

Descriptors: *Pesticides, *Degradation, *Waste disposal, *Soil-water systems, Atrazine, Alachlor, 2,4-D, Trifluralin, Carbaryl, Parathion, Insecticides, Herbicides, Organic compounds.

Atrazine, alachlor, 2,4-D ester, trifluralin, carbaryl, and parathion were added individually and as mixtures to 60 L of water and 15 kg of soil held in 1100 L plastic garbage containers that were buried partially in open ground to determine if controlled soil-water systems are satisfactory for the disposal of small amounts of formulated pesticides. Additional variables of aeration at 1 l/min and peptone nutrients at 0.1 weight percent were also studied. Aliquots from 56 buried containers were taken for chemical analyses during a 68 week period. Soil and water in an inexpensive container provide for satisfactory containment of common pesticides so that chemical and biological degradation can occur. The soil is a source of microorganisms, a food source and a great aid to containment because of its high adsorption capacity. The water is an aid in monitoring and for microbiological activity. Aeration and addition of buffers, nutrients and inoculants are of questionable value. Volatilization losses should be insignificant since even the very volatile trifluralin was not lost. Atrazine and alachlor are both very persistent. The use of half-life to estimate the persistance of a pesticide in the natural environment is a debatable practice. (Baker-IVI)
W85-06780

LEACHABILITY AND REVEGETATION OF SOLID WASTE FROM MINING,
Industrial Environmental Research Lab.-Cincinnati, OH.
For primary bibliographic entry see Field 5G.
W85-06990

LAND DISPOSAL OF SEWAGE SLUDGE, VOL VIII: APRIL 1, 1979 - MARCH 31, 1980,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
T. E. Bates, and Y. K. Soon.
Environmental Canada, Canada-Ontario Agreement on Great Lakes Water Quality, Research Report No. 108, 1981. 17 p, 5 Tab. Ontario Lottery No: 12.

Descriptors: *Metals, *Sludge disposal, *Sludge utilization, *Nutrients, *Crop yield, *Bioaccumulation, *Soil amendments, *Land disposal, Heavy metals, Phosphorus, Phosphorus removal, Crop production, Plant growth, Bye, Bromegrass.

Three sludges resulting from the treatment of sewage for P removal with calcium hydroxide, ferric chloride and aluminum sulfate were compared to ammonium nitrate fertilizer as sources of N, and their effects on crop yield and nutrient and metal content of crops and soil were measured. In a second study, crop growth and the uptake of nutrients and metal were measured for six sewage sludges with high metal contents. Yields of bromegrass and corn resulting from sludge application were at least as high as yields with ammonium nitrate. Sodium bicarbonate extractable soil P was increased by sludge application in the order Ca sludge > Fe sludge > Al sludge. Soil pH and extractable soil Ca were highest with Ca sludge, and soil pH was lowest with Fe sludge. Ca, Cu, Ni, and Zn concentrations in plant tissues increased with sludge application rates, and were particularly high with applications of sludges high in these metals. Root, shoot and soil analysis of greenhouse grown ryegrass crops showed, after the fourteenth harvesting, low mobility of Pb and Cr in the soil-plant system. Cd and Cu were readily absorbed by the root, but were not so readily transported to the shoot. With the exception of Zn, metal concentration were generally much higher in the root than in the shoot, as evidenced by root/shoot metal concentration ratios.
W85-06991

SLUDGE INCINERATION AND PRECIPITANT RECOVERY, VOL. IV: PILOT SCALE MULTIPLE-HEARTH FURNACE INVESTIGATIONS,
Department of the Environment, Ottawa (Ontario).
W. H. Schroeder, P. J. Crescuolo, H. W. Campbell, and D. B. Cohen.
Environment Canada, Canada-Ontario Agreement on Great Lakes Water Quality, Research Report No. 107, 1981. 51 p, 7 Fig, 8 Tab, 13 Ref, 2 Append. Project No. 72-3-4.

Descriptors: *Sludge disposal, *Solid waste disposal, *Pilot plants, *Trace metals, *Trace elements, *Incineration, *Municipal wastes, *Carbon, Calcium, Metals, Waste disposal, Silica, Heavy metals, Sludge drying.

Pilot scale multiple-hearth sludge incineration was carried out at the Hamilton Water Pollution Control Plant to determine the fate of a selected number of elements within a normal operating range for the handling of municipal sewage sludge. Optimal and/or boundary conditions of temperature, throughout capacity, and center shaft speed were determined with regard to the prevention of clinker formation and minimization of the residual organic content of the incinerator ash. Under the constraints of the experiment, P, Zn, Fe, Mg, Al, Ni, Cu, Ca, Cr, Pb and Si proved conservative and remained in the ash while varying proportions of Cd, Hg, and As were removed to the gas stream. Minimum levels of total C destruction were 98.7%. The most important factor in determining the auxiliary fuel consumption is the water content of the feed sludge. Clinker formation could be avoided at high temperatures (928 degrees) by ensuring a short residence time within the furnace by increasing throughput rate and center shaft speed.
W85-06992

BED DEFORMATION IN CURVED ALLUVIAL CHANNELS,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 2J.
W85-07033

SLUDGE REDUCTION BY IN-PLANT PROCESS MODIFICATION: NEW YORK CITY'S EXPERIENCES,
New York City Dept. of Environmental Protection, Wards Island. Div. of West Operations.
L. A. Carrio, A. R. Lopez, P. J. Krasnoff, and J. J. Donnellon.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 116-121, February, 1985. 6 Fig, 8 Tab.

Descriptors: *Sludge digestion, *New York City, *New York, *Sludge disposal, Wastewater treatment, Anaerobic digestion, Sludge thickening.

Sludge treatments common to all New York City plants involves gravity thickening and anaerobic digestion in the high rate mode. The raw sludge is digested for stabilization and odor elimination because the plants are located in densely populated areas. After digestion, the sludge produced is stored on site. The sludge is disposed of at sea by a fleet of four City owned self-propelled sludge vessels. Recirculation of digested sludge to earlier stages in the wastewater treatment process is a practice that has been used in the city facilities for many years. Recirculated sludge was returned through exits in piping to the thickener influent, the aerators and the head of the plant. The usefulness of decanting operations, elutriation, and thermophilic digestion incorporated into the sludge treatment procedures has been investigated. Sludge volume to sea and disposal costs were reduced by simple in plant process modifications. Sludge

volume reduction was maximized by a combination of processes. The process modifications were simple to operate and did not require sophisticated testing procedures or knowledge of process control other than that normally required of plant operating personnel. Sludge volume reductions were accomplished without increased manpower requirements and without chemical addition. The additional power consumer in some of the operation was negligible when compared to the savings resulting from the reduction in sludge volume. The process control modifications for sludge volume reduction did not have any significant adverse effect on plant treatment efficiency. (Baker-IVI)
W85-07039

MATERIALS BALANCE IN THE COMPOSTING OF WASTEWATER SLUDGE AS AFFECTED BY PROCESS CONTROL STRATEGY,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
F. C. Miller, and M. S. Finstein.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 122-127, February, 1985. 1 Fig, 6 Tab, 22 Ref. EPA project R806829010.

Descriptors: *Sludge composting, *Wastewater treatment, Sludge digestion, Landfills, Decomposition, Composting.

A previously reported field comparison between two fundamentally different composting process control strategies has been extended to consider materials balance. Both strategies were implemented in static pile configuration: each pile consisted of 36.3 wet metric tons of a mixture of raw wastewater sludge and woodchips (bulking agent). The comparative process performance was as follows: composting time, 12.4 days (Rutgers strategy) compared to 20.8 days (Beltsville Process); total dry sludge solids decomposed, 41.8% (Rutgers strategy) compared to 11.3% (Beltsville Process); volatile dry sludge solids decomposed, 56.9% (Rutgers strategy) compared to 15.4% (Beltsville Process); and water removed, 78.2% (Rutgers strategy) compared to 19.4% (Beltsville Process). In calculating the extent of decomposition, the woodchips were assumed to remain unchanged. In a separate field trial that involved only the Rutgers strategy, woodchips were replaced with recycled compost as the bulking agent. Using a dry weight recycle ratio of three parts sludge to one part recycled compost (pile wet weight, 6 metric tons), the outcome was as follows (solids refers to the mixture of sludge and compost): composting time, 9.5 days; total dry solids decomposed, 24.7%; volatile dry solids decomposed, 36.4%, and water removed, 85.4%. (Baker-IVI)
W85-07040

CHARACTERISTICS OF ACTIVATED SLUDGE EFFLUENTS BEFORE AND AFTER OZONATION,
Purdue Univ., Lafayette, IN. Dept. of Environmental Engineering.
R. D. Watt, E. J. Kirsch, and C. P. L. Grady, Jr.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 157-166, February, 1985. 6 Fig, 7 Tab, 48 Ref.

Descriptors: *Ozonation, *Sludge treatment, Wastewater treatment, Organic compounds, Biodegradability, Dissolved oxygen, Hydrogen ion concentration.

Research was conducted to determine how ozonation influenced the characteristics of dissolved organic matter in effluents from activated sludge reactors, and to determine whether manipulation of environmental variables, such as the pH and dissolved oxygen (DO) concentration, in the bioreactor affected the nature of the ozonated effluents. Ozonation of effluents from lab scale activated sludge reactors to a dissolved ozone residual of 0.30 to 0.35 mg/L after 5 minutes of contact did not significantly reduce DO concentration. Ozonation changed the shapes of the isotherms from linear or concave upward to concave downward, and increased the concentration of organic materials which totally resisted removal by carbon adsorption. Ozonation reduced the fraction of organic matter with high molecular weight (greater than 100,000 AMU) and increased the fraction with low molecular weight (less than 1000 AMU). Both pH and DO concentration had significant effects on some characterization parameters. Operation of the bioreactors at 7 mg/L DO produced less nonadsorbable material than did operation at 1 mg/L DO. All three bioreactor variables influenced the amount of nonbiodegradable material in the ozonated effluents, but feed type had the greatest effect. Operation of the bioreactor at pH 6 generated more low molecular weight material and less high molecular weight material in ozonated effluents than did operation at pH 8. (Baker-IVI)
W85-07045

WATER QUALITY IMPACTS OF CHLORINATING PAPERMILL EFFLUENTS,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Water Quality Management.
For primary bibliographic entry see Field 5D.
W85-07047

ALTERNATIVE SLUDGE HANDLING AND DISPOSAL AT KENT COUNTY, DELAWARE,
O'Brien and Gere Engineers, Inc., Blue Bell, PA.
D. R. Pizarro.
Journal of the Water Pollution Control Federation, Vol.57, No. 4, p 278-284, April, 1985. 3 Fig, 6 Tab, 6 Ref.

Descriptors: *Sludge disposal, *Land disposal, *Kent County, *Delaware, Municipal wastes, Sludge drying, Cost analysis.

The development, implementation, and costs of land application of municipal sludges to agricultural land in Kent County, Delaware, are described. Analysis of sludge management costs at Kent County indicate that land application of sludge in liquid form at 5% solids within a 24.1 km haul distance is currently the recommended mode of operation. Land application of cake sludge could be competitive with liquid operations if the current situation changes with regard to land availability or weather constraints. The use of drum thickeners is an effective approach to thicken waste activated sludges, particularly those with poor dewatering characteristics such as extended aeration sludges. Field testing of the oxygenation and mixing capabilities of the submerged turbine aeration system indicate that the application of this equipment for aerobic digestion of sludge at 5% solids is appropriate and will provide significant flexibility from both an operational and an energy-consumption standpoint. A conservative approach should be used to determine land requirements based on sludge analyses and the resulting allowable application rates. Implementation of an effective pretreatment program is necessary to eliminate or minimize the effect of contaminants on land application rates. (Baker-IVI)
W85-07049

WASTE DISPOSAL TECHNOLOGIES FOR POLYCHLORINATED BIPHENYLS,
Oregon State Univ., Corvallis. Dept. of Statistics.
W. T. Piver, and F. T. Lindstrom.
Environmental Health Perspectives, Vol. 59, p 163-177, February, 1985. 9 Fig, 3 Tab, 62 Ref.

Descriptors: *Waste disposal, *Polychlorinated biphenyls, *Dioxins, *Incineration, *Hazardous waste disposal, Source of pollutants, Path of pollutants, Unsaturated zone, Groundwater contamination.

Improper practices in the disposal of polychlorinated biphenyl (PCB) wastes by land burial, chemical means and incineration distribute these chemicals and related compounds such as polychlorinated dibenzofurans (PCDFs) and polychlorinated dibenzodioxins (PCDDs) throughout the environment. The complete range of methods for disposal that have been proposed and are in use were analyzed, with emphasis given to the two most commonly used methods: land burial and incineration. The understanding of aquifer contamination caused by migration of PCBs from subsurface burial sites requires a description of the physical, chemical and biological processes governing transport in unsaturated and saturated soils. For this purpose, a model was developed and solved for different soil conditions and external driving functions. The model couples together the fundamental transport phenomena for heat, mass, and moisture flow within the soil. To rehabilitate a contaminated aquifer, contaminated groundwaters are withdrawn through drainage wells, PCBs are extracted with solvents or activated carbon and treated by chemical, photochemical or thermal methods. The chemical and photochemical methods were reviewed with primary emphasis devoted to the use of incineration as the preferred method of disposal. Performance characteristics of different thermal destructors were analyzed with consideration given to the formation of PCDFs and PCDDs during combustion from chloroaromatic, chloroaliphatic, as well as organic and inorganic chloride precursors. To understand how this information can be used, basic design equations were developed from governing heat and mass balances that can be applied to the construction of incinerators capable of more than 99.99% destruction with minimal to nondetectable levels of PCDFs and PCDDs. (Author's abstract)
W85-07074

SHOULD SEWAGE BE DISCHARGED AT THE WATER SURFACE OR NEAR THE BED,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol. 152, p 443-454, March, 1985. 6 Fig, 14 Ref.

Descriptors: *Wastewater discharge, *Bacteria, *Flow, Dilution, Light intensity, Fluid mechanics, Radioactive wastes, Marine environment.

The mortality of bacteria in sewage discharges into shallow seas is strongly influenced by light and varies with distance from the free surface. A criterion is derived for deciding between the opposing strategies of getting rapid bacterial decay by directing the sewage up to the surface at the sacrifice of initial dilution, or of achieving high initial dilution with a distributed source along the bed perpendicular to the flow direction. For steady discharges in flowing water, the contaminant plume is greatly elongated in the flow direction. Not only does this mean that longitudinal concentration gradients are much smaller than transverse gradients, but also in the longitudinal direction the effects of diffusion are overwhelmed by advection. At large distances downstream the transverse concentration profile becomes Gaussian. Whenever possible sewage works, and the associated sewage outfalls, are not situated in high-amenity areas. In examining the benefits of surface vs bottom discharges, it is found that at large distances a bottom discharge would need to be sufficiently wide in order to achieve the same concentration as from a narrow surface discharge. Conversely, a radioactive discharge with specified parameters is best discharged at the bed. In one case the dominant physical effect is the enhanced decay rate near the surface, while in the other it is the small extra amount of time taken for the radioactive contaminant to diffuse into the faster moving part of the flow. (Baker-IVI)
W85-07086

CHEMICAL CLEANING WASTE DISPOSAL BY LANDFARMING,
Arkansas Power and Light Co., Little Rock.
E. L. Green, and D. W. Moore.
Power Engineering, Vol. 89, No. 5, p 44-45, May, 1985. 1 Fig, 2 Tab.

Descriptors: *Ammoniated citric acid, *Wastewater disposal, *Wastewater treatment, Economic factors, Ammonia, Land disposal.

Recycling spent nonhazardous chemical cleaning waste by landfarming offers economic and environmental benefits. The advantages of the process were demonstrated after the application of ammoniated citric acid wastewater. In the course of reviewing proposals from various contractors for a new approach for wastewater disposal at Arkansas

Nuclear One, landfarming was considered. The method appeared to offer major advantages. First, the cost was less than half of conventional precipitation or demineralization methods. Second, landfarming converted a waste product to an environmentally beneficial end use. Land application of the waste material was expected to pose no toxic problems and the nitrogen in the waste would demonstrate beneficial results. The site is undulating, with a 0-10% slope. The soils offer percolation rates of 1/2 in/hr and a cation exchange capacity sufficient to treat the ammoniated citric acid. The soil type and its current nitrogen content indicated that the soil could accomodate 500 lb/acre of nitrogen. Tests indicated that the wastewater could safely be applied at a single application rate up to 4000 gal/acre. After the test application no ammonia odor was detected in the buffer zone areas, either before or after rainfall. No odor complaints were received from nearby homeowners. The ammoniated citric acid was applied to about 70 acres at the Lynch power plant in the summer of 1983. Broadleaf weeds were killed in all treated areas and did not return in the three month period. Narrow-leaf grass plants were not harmed. Landfarming thus has merit for nonhazardous wastewater disposal. (Baker-IVI)
W85-07097

REMOVAL OF NITROGEN FROM WASTEWATER BY SOIL PERCOLATION WITH ALTERNATE FLOODING AND DRYING,
Murdoch Univ. (Western Australia). School of Environmental and Life Science.
K. Mathew, G. E. Ho, and P. W. G. Newman.
Asian Environment, Vol. 6, No. 4, p 9-16, 1984. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Nitrogen removal, *Denitrification, *Percolation, *Soil properties, *Land disposal, Wastewater disposal, Flooding, Drying, Nitrification, Alluvial soil, Model studies.

The removal of nitrogen from sewage effluent during soil percolation by alternate flooding and drying is an effect of many processes. Data are provided on an experimental determination of dispersion and adsorption properties of an alluvial soil and the rate of nitrification and denitrification in this soil. The effects of infiltration rate and periods of flooding and drying on removal efficiency were also determined by a simple model. Only a soil with cation exchange capacity of at least 5 meq/100 g can provide for adequate removal of nitrogen. At the same time the soil should have a hydraulic conductivity which allows the required recharge velocity. If the amount of ammonium applied during a flooding period is more than the ammonium nitrified in the drying period ammonium will be leached into groundwater. The concentration and the quantity can be calculated by using the model developed. The nitrate in the soil will be leached out to be groundwater along with the wetting front of the incoming flow. The amount of nitrate leached out can be reduced by increasing the denitrification rate by adding organic carbon and increasing the period of denitrification by reducing infiltration rate. Using the model the percentage removal of nitrogen can be estimated for a given scheme. On using Pyrton Sandy Loam at the recharge site with 1 day flooding and 12 days drying at an infiltration rate of 23 cm/day it is predicted that up to 90% nitrogen could be removed. (Baker-IVI)
W85-07107

5F. Water Treatment and Quality Alteration

OXIDATION OF ORGANIC COMPOUNDS THROUGH THE COMBINATION OZONE-HYDROGEN PEROXIDE,
Compagnie Generale des Eaux, Paris (France).
R. Brunet, M. M. Bourbigot, and M. Dore.
Ozone: Science and Engineering, Vol. 6, No. 3, p 163-183, 1984. 21 Fig, 17 Ref.

Descriptors: *Water treatment, *Ozone, *Hydrogen peroxide, *Organic compounds, Drinking water, Ozonation, Oxidation, Irradiation, Chemical reactions.

Short chain organic compounds are formed during the treatment of drinking water with ozone. These compounds are not very adsorbable and are partly responsible for the residual organic carbon content in distributed water. The generation of very reactive oxidant entities in the medium without modifying its characteristics would help rid the water of these chemicals. The initiation of radicals is one such method and can be done through irradiation or through the combined action of oxidants such as hydrogen peroxide associated with ozone. The action of the couple ozone-hydrogen peroxide on various organic compounds was studied in solution with water. The results were compared with oxidation uniquely using ozone or hydrogen peroxide. Among the organic compounds studied there are compounds that are more or less readily oxidizable by ozone, and stable oxidation products. The merits of the combined treatment were demonstrated, particularly with respect to the oxidation of certain carbonyl compounds during water ozonation which are stable towards ozone. (Baker-IVI)
W85-06212

OZONATION SCHEMES OF ORGANO PHOSPHORUS PESTICIDES APPLICATION IN DRINKING WATER TREATMENT,
Ecole Nationale Superieure de Chimie de Rennes (France). Lab. de Chimie des Nuisances et Genie de l'Environnement.
A. Laplanche, G. Martin, and F. Tonnard.
Ozone: Science and Engineering, Vol. 6, No. 3, p 207-219, 1984. 10 Tab, 15 Ref.

Descriptors: *Ozonation, *Drinking water, *Water treatment, *Organophosphorus pesticides, Ozone, Oxidation, Chemical reactions, Pesticides.

The behavior of organophosphorus pesticides towards ozone is studied. Experiments were performed in organic and aqueous solution on representative molecules of various organophosphorus families. After identification of the main products of oxidation reactions, the evolution of starting and resulting compounds was followed. For phosphorothioates, a cycloaddition of ozone occurs on the double bond P=S before the molecule breaks down. For phosphorodithioates, a competitive reaction occurs between the precedent cycloaddition and the electrophilic attack of oxidant on the second sulfur. For phosphoroamidates, the same electrophilic attack was noted on the nitrogen. After formation of the intial adduct the free point of the ozone molecule can go either on the phosphorus or the carbon atom adjacent to heteroatom, and this constitutes a cyclic intermediate leading to different isolated products. (Baker-IVI)
W85-06214

BOILING OF DRINKING-WATER: CAN A FUEL-SCARCE COMMUNITY AFFORD IT,
Baltimore City Hospitals, MD.
R. H. Gilman, and P. Skillicorn.
Bulletin of the World Health Organization, Vol. 63, No. 1, p 157-163, 1985. 2 Tab, 8 Ref.

Descriptors: *Public health, *Drinking water, *Boiling, *Costs, *Bangladesh, Water treatment, Developing countries, Sanitation, Economic factors.

The financial feasibility of boiling drinking water in efforts to control and prevent diarrhea for a village in Bangladesh was investigated. Family income was categorized and the pattern of household fuel consumption determined. Families in the lowest income quartile would have to spend about 22% of their yearly income on fuel, and those in the highest income bracket about 10%. Boiling of drinking water would result in an 11% increase in the household budget for a typical family in the lowest income quartile, compared with a 3% increase for a typical family in the highest income quartile. Recommendations concerning boiling of drinking water in developing countries should not be urged until some provision for the economic feasibility of this approach is undertaken. (Baker-IVI)
W85-06217

FORMS OF OCCURRENCE OF FLUORINE IN DRINKING WATER,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
P. Pitter.
Water Research, Vol. 19, No. 3, p 281-284, 1985. 8 Fig, 2 Tab, 10 Ref.

Descriptors: *Drinking water, *Fluorides, *Oxidation, *Fluoroaluminates, Chemical reactions, Alum, Fluoridation, Water treatment, Hydrolysis, Protonation.

Alum coagulation and fluoridation are common processes in many water treatment plants. Under these conditions, fluorine may be present in treated water as less physiologically active fluoroaluminates. The results of a mathematical analysis of the corresponding chemical equilibria are presented. At least two possible side reactions must be considered, protonation and hydrolysis. In neutral and alkaline solutions, fluoroaluminates will be, under given conditions, converted to hydroxoaluminates so that the total fluoride concentration can be considered approximately equal to the free fluoride ions. Among the many methods suggested for the determination of fluoride ion in water, the electrode method is the most satisfactory at the present time. In acid solutions the presence of fluoroaluminates might be significant. (Baker-IVI)
W85-06218

REMOVAL OF ORGANIC PRECURSORS BY PERMANGANATE OXIDATION AND ALUM COAGULATION,
Hercules, Inc., Wilmington, DE.
B. Moyers, and J. S. Wu.
Water Research, Vol. 19, No. 3, p 309-314, 1985. 1 Fig, 5 Tab, 14 Ref.

Descriptors: *Trihalomethanes, *Organic compounds, *Permanganate, *Alum, Oxidation, Coagulation, Water treatment, Phenols, Anilines, Aliphatic diketones, Chloroform, Humic acid.

Much is known about the removal and reaction mechanisms of the naturally occurring precursors of trihalomethanes such a humic and fulvic acids. However, another class of precursors including phenols, anilines and aliphatic diketones has not been thoroughly investigated. This study shows that these truly soluble, monomeric precursors are poorly removed by alum coagulation. The use of permanganate preceding alum coagulation provides a good reduction of chloroform in water samples containing high proportions of monomeric precursors. The process was found to be less effective for water samples containing a high proportion of humic acid. This is possibly due to the degradation products from the permanganate oxidation of humic acid. These degradation products are not readily removed by alum coagulation and become available for subsequent chloroform formation. (Author's abstract)
W85-06222

FIELD OBSERVATIONS ON THE OCCURRENCE OF NEW INDICATORS OF DISINFECTION EFFICIENCY,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5A.
W85-06224

REMOVAL OF ORGANICS FROM WATER IN AN AERATION BASIN; A MATHEMATICAL MODEL,
Washington Univ., Seattle. Dept. of Chemical Engineering.
G. W. Albin, and G. C. Holdren.
Water Research, Vol. 19, No. 3, p 363-371, 1985. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Aeration, *Organic compounds, *Mathematical models, Air stripping, Water treatment, Drinking water, Volatile compounds, Temperature, Bubbles, Residence time.

Air stripping is one of the treatment methods that has been widely considered for the removal of volatile organics from drinking water. Aeration is generally most effective in removing low molecular weight organics, including trihalomethanes and many industrial solvents. A mathematical model was developed to describe the removal of volatile organic compounds from drinking water in aeration basins. The model was used to simulate removal under a range of expected treatment conditions using the Continuous Systems Modeling Program. Temperature and air-to-water ratio are the major factors influencing the removal of chloroform from water in an aeration basin. Bubble diameter was a lesser factor while liquid residence time had the smallest effect of the variables examined. The model can be used to evaluate the applicability of aeration basins for organics removal. Because basin size is relatively unimportant, it may be possible to convert existing treatment basins, such as softening basins, for this purpose. (Moore-IVI)
W85-06229

COST EFFECTIVE OPERATION OF URBAN WATER SUPPLY SYSTEM USING DYNAMIC PROGRAMMING,
California State Dept. of Water Resources, Woodland.
M. H. Sabet, and O. J. Helweg.
Water Resources Bulletin, Vol. 21, No. 1, p 75-81, February, 1985. 7 Fig, 3 Tab, 14 Ref.

Descriptors: *Water conveyance, *Urban areas, *Dynamic programming, *Cost analysis, Municipal water, Utilities, Costs, Groundwater, Optimization, Pipelines, Network analysis, Energy costs.

Efficient operation of a city water supply system is an important goal of all municipalities. Efficient operation should result in minimum operation cost through reduction in total energy use and/or reduction in on-peak energy consumption. An optimization model was designed for operating the water supply systems of cities using groundwater. The Newton-Raphson pipe network was used for network analysis and a dynamic programming optimization algorithm was used for determining a schedule for pump operation in the pipe network system. The model is most suitable for use in small cities with up to 45,000 in population, but with large-scale disintegration techniques may also be used for larger cities. The savings in operation costs are a function of energy cost and energy use pattern and water use pattern in the area. (Author's abstract)
W85-06241

PROBLEMS IN WATER CONTAMINATION AND ITS ANALYTICAL UNDERSTANDING (PROBLEME DER WASSERKONTAMINATION UND IHRER ANALYTISCHEN ERFASSUNG),
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
For primary bibliographic entry see Field 5A.
W85-06267

COMPARATIVE STUDIES FOR INDICATION OF CHLORINE IN DRINKING AND BATHING WATER ON THE BASIS OF O-TOLIDINE AND DIETHYL-P-PHENYLENEDIAMINE (DPD) (VERGLEICHENDE UNTERSUCHUNGEN ZUM NACHWEIS VON CHLOR IM TRINK- UND BADEWASSER AUF DER BASIS VON O-TOLIDIN UND DIATHYL-P-PHENYLENDIAMIN (DPD)),
Bezirks-Hygieneinspektion und -Inst., Erfurt (German D.R.).
P. M. Theus, and U. Ponsold.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No 5, p 583-594, 1983. 5 Fig, 21 Ref.

Descriptors: *Chlorine, *Tolidine, *Diethyl-p-phenylenediamine, *Drinking water, *Photometry, Water treatment, Measuring instruments, Photometer, Water analysis.

The detection of free chlorine with the aid of o-tolidine is connected with systematic errors within the range of concentrations below 0.1 mg/l and above 0.7 mg/l, reproducibility being otherwise good. In the case of the simultaneous presence of free and bound active chlorine, especially in bathing water, this method determines 50-70% of varying shares of the bound chlorine depending on the reaction time. As detailed statistical investigations have shown, the determination of chlorine with the aid of diethyl-p-phenylenediamine (DPD) by the Palin method is free of systematic errors and correctly determines free and bound active chlorine with detection limits of 0.03 mg/l. Also low concentrations of free chlorine together with high concentrations of monochloro amine can be safely detected. Therefore, the DPD method is recommended as a standard method, and for the waterworks practice a battery-operated chlorine photometer is developed for rapid determinations. (Author's abstract)
W85-06276

ACID RAIN AND DRINKING WATER DEGRADATION,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 5B.
W85-06286

EFFECT OF RESERVOIR INDUCED CIRCULATION ON THE WATER QUALITY OF RECREATIONAL FRESHWATER EMBAYMENTS,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W85-06317

FY 83 PROGRAM SUMMARY REPORT OF UTAH CENTER FOR WATER RESOURCES RESEARCH,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 9D.
W85-06322

STATISTICAL COMPARISON OF A DIRECT FILTRATION AND A CONVENTIONAL WATER TREATMENT FACILITY IN THE INTERMOUNTAIN REGION,
Utah Water Research Lab., Logan.
S. Burns, and V. D. Adams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157816/AS, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, Sept. 1984. 66 p, 14 Fig, 6 Tab, 41 Ref, 2 Append, USGS G872-05.

Descriptors: Drinking water, *Water treatment, *Filtration, Particulate matter, Turbidity.

More stringent EPA standards are causing many communities to search out a cost effective treatment method for reducing drinking water turbidity. Conventional processes employ flocculation, costly settling basins, and polishing filters. Recently developed mixed media filters can be kept from clogging and permit direct filtration without first passing the water through settling basins. Because of the reduced capital costs, space requirements, sludge quantities, and coagulant dosages, direct filtration is being increasingly employed at new plants around the world. The specific objectives of this research were to review the literature to determine the factors affecting the performance of direct filtration systems and to use this background in gathering time series of data on relevant parameters for comparing the performance of a direct filtration with a conventional treatment system. A comparison of the turbidities of the water treated at the Utah Valley Water Purification Plant at Orem, Utah, with the water treated at the Little Cottonwood Metropolitan Treatment Plant at Salt Lake City over a three-year period showed no significant difference. Furthermore, the water produced by both plants was far below the standard of 1 TU required by EPA. Direct was thus found to perform satisfactorily in turbidity removal.
W85-06324

CONSUMER ATTITUDES TOWARD PUBLIC WATER SUPPLY QUALITY: DISSATISFACTION AND ALTERNATIVE WATER SOURCES,
Southern Illinois Univ. at Carbondale.
For primary bibliographic entry see Field 6D.
W85-06347

BROMIDE-OXIDATION INTERACTIONS AND THM FORMATION: A LITERATURE REVIEW,
Capitol District Library Council for Reference and Research Resources, Troy, NY.
For primary bibliographic entry see Field 5B.
W85-06490

SURROGATE PARAMETERS FOR MONITORING ORGANIC MATTER AND THM PRECURSORS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
J. K. Edzwald, W. C. Becker, and K. L. Wattier.
Journal of the American Water Works Association, Vol. 77, No. 4, p 122-132, April, 1985. 14 Fig, 12 Tab, 38 Ref.

Descriptors: *Monitoring, *Organic compounds, *Water quality control, *Trihalomethanes, *Grasse River, *Glenmore Reservoir, *New York, Rivers, Reservoirs, Pollutant identification, Ultraviolet, Water treatment, Pilot plants, Chlorination.

UV (254 nm) absorbance is a good surrogate parameter for nonpurgeable total organic carbon (NPTOC) and total trihalomethane formation potential (TTHMFP). UV absorbance can be used to estimate the NPTOC and TTHMFP (THM precursors) concentrations of raw waters, to monitor pilot-plant performance, and to monitor full-scale water treatment plant performance. Based on the NPTOC-UV regression equations, TTHMFP-NPTOC regression equations, seasonal THM yields, and UV to TOC ratios for the two waters (Grasse River and Glenmore Reservoir in New York) the nature of the organic matter in a highly colored, humic stream such as Grasse River is different from that in the protected, upland reservoir. Even so the THM precursors in the two supplies are similar in terms of relating their concentrations as TTHMFPs to UV absorbance. The raw water surrogate equations developed from the Grasse River data were tested successfully on other waters. Direct filtration pilot-plant data demonstrated that UV can be used to monitor pilot-plant performance for removals of NPTOC and THM precursors. For two plants studied, UV was an excellent predictor of plant performance for removals of NPTOC and THM precursors. Instantaneous TTHMs of the finished waters can be predicted from raw water UV, finished water pH, chlorine consumption, and temperature data. Particular attention should be given to the selection of sampling locations and to the sample-handling conditions. (Baker-IVI)
W85-06491

REMOVING HUMIC SUBSTANCES BY CHEMICAL TREATMENT AND ADSORPTION,
Michigan Univ., Ann Arbor.
W. J. Weber, Jr., and A. M. Jodellah.
Journal of the American Water Works Association, Vol. 77, No. 4, p 132-137, April, 1985. 9 Fig, 4 Tab, 6 Ref. EPA Grant 80735901.

Descriptors: *Alum, *Lime, *Water treatment, *Total organic carbon, Organic matter, Adsorption, Chemical reactions, Humic acids, Coagulants.

Humic substances comprise the major class of organic matter in natural waters. Alum coagulation and lime softening exhibit variable effectiveness for removing the total organic carbon (TOC) associated with humic substances in water supplies. This variability related primarily to differences in sources and types of humic matter. Both alum and lime treatment result in humic residuals that manifest different adsorption characteristics than those present in the same waters prior to chemical pretreatment. This appears to relate more to modification of humic acid speciation than to changes in the inorganic composition of the water from which adsorption occurs, although the latter effect has been observed to have an influence under certain conditions. The extent of alterations in adsorption behavior again depends on the origin and type of

the humic materials involved. Alum coagulation appears to generally improve overall adsorbability, at least for the TOC associates with the humic solutions tested in this work. (Baker-IVI)
W85-06492

ENERGY REQUIREMENTS FOR AIR STRIPPING TRIHALOMETHANES,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, and J. A. Levy.
Journal of the American Water Works Association, Vol. 77, No. 4, p 138-146, April, 1985. 16 Fig, 3 Tab, 35 Ref.

Descriptors: *Air stripping, *Trihalomethanes, *Water treatment, Energy, Economic aspects, Energy, Design criteria, Drinking water, Water management, Aeration, Costs.

Design methods for surface aeration and for countercurrent packed columns are reviewed. Methods for estimating energy requirements to achieve chosen treatment objectives are presented and the efficacy of multiple staging of surface aeration basins are demonstrated. Energy requirements for multiple-stage surface aeration versus countercurrent air stripping are compared. The risks of improperly neglecting the gas-phase transfer resistance when dealing with trihalomethane (THM) stripping are demonstrated. The energy comparison shows a standoff between the countercurrent packed column and mechanical surface aeration processes for air stripping of THMs. Mechanical surface aeration requires greater land area than the packed-column alternative. In climates where subfreezing temperatures are common, freezing of open aeration basins might present problems. The capital investment is likely to be less for mechanical surface aeration than for packed-tower contacting, if land is available at a reasonable cost. The operating and maintenance labor costs will be smaller for mechanical surface aeration, especially if there is a risk of chemical precipitation or biological growth that would tend to clog a packed column, necessitating frequent shutdowns for cleaning. Mechanical surface aeration offers many advantages for air stripping of THMs in water treatment. The process is simple to build and operate, there is a great deal of pertinent experience with oxygen transfer applications, and the energy requirements are not substantially greater than for packed column contacting. (Baker-IVI)
W85-06493

ORGANIC HALOGEN MEASUREMENTS: CURRENT USES AND FUTURE PROSPECTS,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W85-06494

DECHLORINATION AND TRIHALOMETHANE YIELDS,
Maryland Univ., College Park. Dept. of Chemistry.
G. R. Helz, A. D. Uhler, and R. Sugam.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 4, p 497-503, April, 1985. 1 Fig, 3 Tab, 8 Ref. Electric Power Research Inst., Palo Alto, Ca. contract RP 733-1.

Descriptors: *Trihalomethanes, *Dechlorination, *Chlorination, Water treatment, Powerplants, Cooling water, Effluents,.

Chlorinated effuents are sources of both trihalomethanes and macromolecular halocarbons. At power plants, chlorine is used to control fouling in cooling water, so contact times of only a few minutes are sufficient. Tests were run to determine whether dechlorination after chlorine contact times of only a few minutes can reduce or eliminate trihalomethane emissions. When the chlorine dose was sufficient to give a residual of 15 microM (1 mg/L) or less at the condenser outlet, trihalomethanes were undetectable. At higher chlorination rates, the trihalomethane yield increased with dose. Dechlorination appears to be more effective at reducing $CHCl_3$ yields than at reducing $CHBrCl_2$ yields. The findings indicate that the benefits of dechlorination can include reduction in trihalomethanes, as well as oxidant emissions. (Baker-IVI)
W85-06527

HEAVY METALS IN THE DRINKING WATER FROM CISTERNS SUPPLYING SINGLE-FAMILY DWELLINGS,
Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
A. F. Gumbs, and F. E. Dierberg.
Water International, Vol. 10, No. 1, p 22-28, March, 1985. 1 Fig, 2 Tab, 26 Ref.

Descriptors: *Heavy metals, *Drinking water, *Cisterns, *St. Maarten, *Netherlands Antilles, Cadmium, Chromium, Lead, Zinc, Water quality control.

Heavy metal concentrations (cadmium, chromium, lead, zinc) in 46 cistern water supply systems from single-family dwellings on St. Maarten, Netherlands Antilles were considerably below US drinking water limits in most cases. St. Maarten is a Caribbean island which has an annual mean temperature of 27 C and 114 cm of rainfall per year. The topography of the island is mountainous and plays an important part in promoting rainfall from easterly tradewinds. The cistern system typically consists of the house roof which serves as an impervious catchment for precipitation. The catchment surface is commonly constructed of corrugated galvanized iron sheets. In the rain water cistern system zinc was the most abundant metal in bulk precipitation followed by lead, chromium, and then cadmium. Mean concentrations were higher than the average cistern surface concentrations, suggesting that particulate matter containing heavy metals settled out of suspension under quiescent conditions in the cistern. Because metal precipitates and particulates are concentrated in the sediment layer of cisterns, care should be exercised in withdrawing water for human consumption. Since running tap water had insignificantly higher levels of zinc, lead and cadmium than the cistern surface water, these metals are released in the distribution system as a result of in-line corrosion processes. (Baker-IVI)
W85-06545

NORTH MIMMS TREATMENT WORKS' REFURBISHMENT AND AUTOMATION,
R. N. Rhodes, and J. M. Stoker.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 1, p 9-26, February, 1985. 5 Fig, 3 Tab.

Descriptors: *Water treatment facilities, *North Mimms Treatment Works, *England, *Automation, Water quality control, Chalk aquifer, Rehabilitation, Design criteria, Construction.

North Mimms Treatment Plant was constructed in 1924 to abstract and treat up to 9 Ml/d of water from a chalk well and adit system. The unusual geological conditions in this area of South Hertfordshire result in a raw water which can fluctuate rapidly in quality between that normally associated with a chalk well, and one which contains a high-loading of colloidal sized clay particles, with turbidities in excess of 80 NTUs. Before refurbishment the station was operated by eight men working on a rotating shift. The treatment process involved flocculation, settlement and rapid gravity filtration, together with superchlorination. Quality of treated water and the efficiency of the works were becoming unacceptable. The experimental, design and construction stages of a new project are described. The experience gained at North Mimms indicates that it is feasible to fully automate a relatively small treatment works and thus make it cost effective. The extensive alarm and fault finding system installed has been effective in both preventing the works from passing unsuitable water into supply and overflowing. In addition, it has allowed for the speedy detection of plant failure. Although careful planning is necessary in this sort of refurbishment, perhaps even more so than on a large works, the flexibility and cooperation of all those concerned is essential if it is to be successfully completed. (Baker-IVI)
W85-06573

APPLICATION OF SCIENCE TO WATER SUPPLY PROJECTS IN DEVELOPING COUNTRIES,
Southern California Metropolitan Water District, Los Angeles.
F. W. Crowley, C. R. Jackson, and T. R. Heard.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 1, p 46-57, February, 1985. 3 Fig, 4 Ref.

Descriptors: *Water supply development, *Developing countries, *Water treatment, Water quality control, Rivers, Groundwater management, Suspended solids, Seawater, Color.

The application of science to the non-engineering parts of a water supply project, particularly those areas related to the quality and treatability of water, is considered. A number of case studies are described to illustrate the wide variety of raw waters which are encountered in countries overseas and some approaches used to determine suitable methods of treatment. The raw waters include two with high suspended solids, one with high color and a unique case of fresh groundwater overlying seawater. Specifics discussed include preparations for fieldwork, sampling water quality and analysis operations, treatability studies, and establishment of water quality criteria and standards. Case studies noted include the River Tigris in Iraq, water supply in greater Algiers, treatment of a highly colored water, and groundwater treatment. (Baker-IVI)
W85-06575

VIRUSES AND DRINKING WATER,
Thames Water Authority (England). Northern Div.
J. S. Slade.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 1, p 71-80, February, 1985. 1 Tab, 16 Ref.

Descriptors: *Drinking water, *Public health, *Viruses, Water quality control, Legislation, United Kingdom, Water treatment, Reviews.

Developments in water virology are examined with particular reference to their implications for potable water supplies. The relevant legislation in the United Kingdom is reviewed and the circumstances under which virological tests can be most usefully employed are defined. An extremely large number of different virus types may be found in natural waters. Specific attention is devoted to four: poliovirus, hepatitis virus A, norwalk virus, and rotavirus. A major consideration in the spread of viruses is the number required to establish an infection - that is, the minimum infective dose. Methods for removing viruses in water are noted and indicators of water quality in relation to virus content are given. (Baker-IVI)
W85-06577

TASTES AND ODORS: THE FLAVOR PROFILE METHOD,
Southern California Metropolitan Water District, La Verne.
S. W. Krasner, M. J. McGuire, and V. B. Ferguson.
Journal of the American Water Works Association, Vol. 77, No. 3, p 34-39, March, 1985. 2 Fig, 4 Tab, 29 Ref.

Descriptors: *Water quality control, *Drinking water, *Taste, *Odor, Organoleptic properties, Testing, Chlorine, Chloramines, Pollutant identification, Microorganisms.

At Metropolitan Water District of Southern California, flavor profile analyses have been used to assist in detecting, controlling and understanding off-flavors in drinking water. Threshold odor number determinations (TON) have often failed in the past to provide sensory data that were of reliable use, except in cases of gross contamination. The flavor-profile panel has been carefully selected and extensively trained in use of the flavor profile

method. The panel has analyzed numerous raw and treated waters and has provided information on the presence and intensity of numerous character notes in these samples. Specific applications have included a determination of the effects on the taste and odor of water when changing from free chlorine to chloramine disinfection. As long as the formation of dichloramine and trichloramine was minimized, the finished water had a lower chlorine like aroma and flavor than the water produced using free chlorine. The flavor profile technique was also used to help elucidate the presence of an industrial contaminant in a domestic water system, and it could also be useful for water utilities that must content with industrial wastes and spills in their source waters. In the case of off-flavors caused by naturally occurring materials, such as MIB produced by microorganisms in the source water, the flavor-profile panel could identify and quantify such odorants even in the presence of other smells and tastes in the sample matrices. (Baker-IVI)
W85-06582

EVALUATION OF PUBLIC NOTIFICATION REQUIREMENTS IN CALIFORNIA,
California Univ., Berkeley. School of Public Health.
For primary bibliographic entry see Field 6E.
W85-06583

USING POLYMERS WITH DIRECT FILTRATION,
East Bay Municipal Utility District, Oakland, CA.
K. E. Carns, and J. D. Parker.
Journal of the American Water Works Association, Vol. 77, No. 3, p 44-49, March, 1985. 5 Fig, 5 Tab, 4 Ref.

Descriptors: *Drinking water, *Filtration, *Polymers, *Water treatment, Turbidity, Alum, Coagulation, Clay, Chlorination, Trihalomethanes.

Clay-polymer coagulation can be used in conjunction with direct, in-line filtration to treat low turbidity waters. Clay-polymer coagulation increases plant capacity by 40-50% because of higher filtration rates and longer filter runs. The effectiveness of clay-polymer coagulation in removing turbidity equals that of alum for raw water turbidity values greater than 3.5 ntu. Clay is essential as a polymer coagulant aid for treatment of water with raw water turbidity less than 3.5 ntu. An increase in clay dosage improves turbidity removal at a constant polymer dosage; a limit to this improvement is reached and more polymer is required for further improvement. An increase in polymer dosage improves turbidity removal at a constant clay dosage to a point, after which no further improvement occurs. A surface wash system is essential to the proper operation of a treatment facility using clay-polymer. Clay polymer coagulation can produce a filtered effluent of less than 0.1 ntu. There are no significant differences in the costs of coagulant for alum-lime, polymer, or clay-polymer coagulation. Clay-polymer coagulation requires at least 50% less water for backwashing than is necessary for alum treatment. Polymer coagulation produces less than 50% of the sludge that is produced during alum treatment. Cationic polymers may exert a chlorine demand of up to 0.6 mg chlorine/1 mg polymer. Cationic polymers have the potential of producing up to 13 microg trihalomethanes/liter. The combination of alum and polymer has the potential for producing excellent quality filtered water at rapid filtration rates of 7 gpm/sq ft and enhancing operational flexibility. (Baker-IVI)
W85-06584

REMOVING COLOR CAUSED BY HUMIC ACIDS,
G. A. Edwards, and A. Amirtharajah.
Journal of the American Water Works Association, Vol. 7, No. 3, p 50-57, March, 1985. 17 Fig, 13 Ref.

Descriptors: *Water treatment, *Color removal, *Humic acids, Coagulation, Acidity, Water quality, Turbidity, Hydrogen ion concentration.

Organics, in the form of humic substances, are undesirable in a potential water supply. Coagulation with aluminum sulfate, a standard procedure for removing suspended colloids, is also an effective method for removing organic color. Optimum domains for the removal of color during the coagulation process were studied in a series of jar tests and diagrammed as an aid to the design and operation of water treatment plants. Optimum color removal areas tend toward lower pH ranges and higher alum dosages as the concentration of humic acid increases. The presence of turbidity in the range of 27-30 tu has little effect on the removal of color. Mechanisms for removal of color appear to be related to those for turbidity removal. At pH ranges above 5.75, the removal mechanism appears to be associated with the formation of aluminum hydroxide precipitate. At pH ranges below 5.75 the removal mechanism is charge neutralization-precipitation of humics. (Baker-IVI)
W85-06585

REMOVING AQUATIC HUMUS FROM NORWEGIAN LAKES,
Norsk Inst. for Vannforskning, Oslo.
E. A. Vik, D. A. Carlson, A. S. Eikum, and E. T. Gjessing.
Journal of American Water Works Association, Vol. 77, No. 3, p 58-66, March, 1985. 16 Fig, 5 Tab, 47 Ref.

Descriptors: *Humus, *Water treatment, *Lakes, *Norway, Lake Tjernsmotjern, Lake Hellerudmyra, Lake Smaputten, Coagulation, Aluminum, Hydrogen ion concentration, Turbidity, Organic carbon.

Research was conducted to clarify the mechanism of removal of aquatic humus by coagulation with aluminum and to determine the optimum coagulant dosage and pH for maximum removal of humus. The maximum possible removal of organic carbon was evaluated for several lake waters. Total organic carbon (TOC) content is probably the best way of describing the humic content of a sample. There was a good correlation betwen TOC and UV absorption and between color and UV absorption. Three different raw waters, from lakes Tjernsmotjern, Hellerudmyra, and Smaputten (Norway) were studied. Conventional coagulation was studied in several series of experiments, in which pH and aluminum dosage were varied. When the sequence of chemical addition was studied, no major differences were found between the case in which alum was added first, immediately followed by NaOH, and the case in which NaOH was added first, immediately followed by alum, as long as the pH was < 7. The optimum pH range broadened with increasing alum dosage, and in all cases of pH of 5.5 was the optimum for efficient coagulation. (Baker-IVI)
W85-06586

POLYELECTROLYTE SELECTION FOR WATER TREATMENT,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
M. M. Ghosh, C. D. Cox, and T. M. Prakash.
Journal of the American Water Works Association, Vol. 77, No. 3, p 67-73, March, 1985. 10 Fig, 3 Tab, 25 Ref.

Descriptors: *Water treatment, *Polyelectrolytes, Filtration, Flocculation, Polymers, Colloidal suspensions.

The interrelationships between polymer molecular weight, charge density, polymer dosage, mixing conditions, and the flocculated particle-size distribution are complex and, in many cases, poorly understood. Flocculation probably takes place according to the mechanism of charge neutralization. However, there are many observations that cannot be explained by this model. Because charge neutralization does not completely explain the data, it appears that polymer bridging plays at least a minor role in flocculation of particles by oppositely charged polyelectrolytes. Although a scientific method of polymer selection is out of reach presently, a basic understanding of the effects of polymer properties on flocculation is beginning to form. For these experiments polymer dosage was independent of molecular weight in most cases. In addition, there appears to be a strong correlation between the number of charges a molecule carries and its optimum flocculation dosage. The size and strength of a floc may be controlled to some extent by proper selection of polymer molecular weight. Accurate and readily available information concerning molecular weight, structure of the polymer, charge density, and concentration of active polymer would greatly simplify further studies in this field and provide a limited basis on which polymer selection could be made. (Baker-IVI)
W85-06587

POLYALUMINUM CHLORIDE AND ALUM COAGULATION OF CLAY-FULVIC ACID SUSPENSIONS,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
B. A. Dempsey, H. Sheu, T. N. T. Ahmed, and J Mentink.
Journal of the American Water Works Association, Vol. 77, No. 3, p 74-80, March, 1985. 12 Fig, 4 Tab, 21 Ref.

Descriptors: *Water treatment, *Polyaluminum chloride, *Coagulation, *Alum, Fulvic acids, Clay, Turbidity, Hydrogen ion concentration, Coagulants.

Polyaluminum chloride (PACl) is an unconventional coagulant that will soon be introduced to the US market. It is produced by partial hydrolysis of aluminum chloride and is thought to consist of stable cationic polymers of aluminum. The benefits of polyaluminum choride relative to alum have been investigated as a function of pH, raw water composition, and mixing conditions. Conditions are outlined that might indicate the effective use of polyaluminum chloride instead of alum. At low to moderate concentration of contaminants, PACl is likely to be a better coagulant than alum. This may be due to the greater charge-neutralizing capability of PACl for the stated conditions. As the concentration of contaminant is increased, then the relative benefits of PACl over alum are decreased. In normal situations, the concentration of fulvic acid or natural organic material will determine the required coagulant dose. Turbidity only slightly influences color removal by increasing the coagulant demand and perhaps by broadening the zone of removal. Floc formed by PACl appears to be very sensitive to shear. Sludge volume is a function of the concentration of the coagulant. At low coagulation concentrations the sludge volume per mass of contaminant removed was low; at high coagulant concentration the sludge volume was high. No differences were observed between PACl and alum for cases in which identical coagulant doses were applied. The coagulant that can be successfully used at the lowest concentration will result in the smallest sludge volume per mass of contaminant removed. (Baker-IVI)
W85-06588

CONTROLLING PHOSPHATE BASED WATER TREATMENT PROGRAMS,
Hercules, Inc., Wilmington, DE.
L. Freedman.
Hydrocarbon Processing, Vol. 64, No. 1, p 81-85, January, 1985. 10 Fig, 6 Ref.

Descriptors: *Phosphates, *Corrosion control, *Water treatment, *Cooling water, Monitoring, Temperature effects, Hydrogen ion concentration, Suspended solids, Hardness, Water properties.

Successful phosphate based cooling water corrosion programs depend upon good feed, control and monitoring. Phosphates can exist in several specific, identifiable forms, each with different properties and inhibitive characteristics. Those discussed include orthophosphates, polyphosphates, and organic phosphates. For a mechanism of corrosion control with phosphates to be effective it must deal with the apparent discrepancies between observations made in operating systems and those from sophisticated instrumental techniques used in research laboratories. Guidelines are offered for high phsophate treatments based on laboratory evaluations and extensive field experience. Probably no system parameter is as important as the control of pH. Methods of control are suggested for hardness,

biological factors, suspended solids, and iron. One limitation to the use of phosphates is that they form their protective films slowly. To compensate for this, a pretreatment stage is typically recommended. The inhibitor is fed at some multiple of the normal recommended level (2.5 to 3.0 times) and is held there for three days to one week. Specifics of system metallurgy, system velocity, temperature and washout time are also addressed. (Baker-IV)
W85-06598

LEAKAGES IN URBAN WATER SYSTEMS: VILLAGE CREEK, CANBERRA, AUSTRALIA,
New South Wales Univ., Kensington (Australia). Faculty of Military Studies.
J. S. Burgess, E. Woolmington, and A. Henderson.
Journal of Environmental Management, Vol. 19, No. 2, p 133-146, September, 1984. 6 Fig, 37 Ref.

Descriptors: *Leakage, *Water conveyance, *Sewerage, *Australia, *Canberra, Village Creek, Diurnal variation, Water loss, Water management, Urban areas, Storm runoff, Streams.

An examination of water discharge and quality indicators in a small stream in Canberra, Australia, reveals that leakages from various engineered water systems into Village Creek produce considerable changes to the natural systems. In Canberra, as in other cities in the developed world with sophisticated systems of water organization, all planning strategies, whatever their specified objectives, are founded upon a dual system of water organization. The dual system comprises the following. The preexisting natural drainage systems, modified by such engineering works as piping, or lining or original stream channels, and accommodating precipitation by hooking up stormwater drainage systems to such channels, thereby preserving the autonomy of rainfall and stream discharge relationships within the original drainage system. Construction of a substantially independent urban water supply sewerage and disposal system to serve the urban area is the second part. Village Creek is one of the numerous tributary systems of the Murrumbidgee River which flow through what is now the Canberra urban area. In its pre-urbanized state it was an ephemeral stream flowing through an area of Quaternay alluvium and Silurian aged volcanic formations. Most of the data from the various water parameters investigated in the study would appear to point in a single direction, namely towards leakages from urban supply/elimination systems into the natural waterway, although some indications are either inexplicable or possibly insignificant. (Baker-IVI)
W85-06603

PHARMACOPEIA REQUIREMENTS AND WATER STANDARDS IN THE UNITED STATES OF AMERICA,
Vaponics, Inc., Plymouth, MA.
For primary bibliographic entry see Field 6D.
W85-06627

CHLORINATION OF HUMIC ACIDS AND CHLOROFORM PRODUCTION,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
V. Janda, and A. Moucha.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 1, p 3-9, 1983. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Trihalomethanes, *Humic acid, *Chloroform, *Chorination, Public health, Drinking water, Water treatment, Organic compounds, Chemical reactions.

This study was designed to reduce the concentration of halogen derivatives in drinking water to as low a value as possible since low molecular chlorinated compounds in drinking water have been shown to present a risk for consumers. Analysis were made of the chlorine, humic matter, pH, and chloroform present in water samples. Humic water samples were prepared by dilution of the humic stock solution in the pure water free of volatile organics. At low concentrations of humic matters and a high dose of chlorine, the concentration of humic matters was a limiting factor from the point of view of chloroform concentration. On the other hand, at high concentrations of humic matters and a low dose of chlorine, the concentration of chlorine is a limiting factor. In the first case organic precursors of chloroform underwent a complete reaction and the higher dose of chlorine did not provide an increasing concentration of chloroform. A similar explanation may be given for the second case. In the water treatment practice these solutions give only a rough semiquantitiative estimate of chloroform concentration in water, because its concentration in water is influenced by the nature of the humic matter, the time of contact of chlorine with water, the temperature of the water and other factors. (Baker-IVI)
W85-06648

HYDROCHEMICAL RESULTS OF THE TREATMENT OF HEAVILY LOADED SURFACE WATER AND BANK FILTRATION WITH HYDRATED LIME. PART 1 (HYDROCHEMISCHE ERGEBNISSE ZUR AUFBEREITUNG STARK BELASTETER OBERFLACHENWASSER UND UFERFILTRATE MIT KALKHYDRAT, TEIL 1),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
L. Bohm.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 2, p 215-222, 1983. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Water treatment, *Hydrated lime, *Filtration, Chemical treatment, Organic matter, Precipitants, Magnesium, Aluminum, Iron, Polymers, Adsorption, Water temperature, Magnetic treatment.

Several laboratory-scale-tested variants of the treatment of organically loaded surface water samples with hydrated lime are described. Possibilities of the additional application of magnesium, aluminum and iron salts and of the anionic polymer 'activated silicic acid' are discussed. The aim has been a considerably reduced application of metallic salts and precipitants at a maximum adsorption of organic pollutants. Another factor influencing crystallization and double hydroxide formation consists of low water temperatures, < 8 C. With the aid of a magnetic treatment, disturbing effects were avoided and even increases of the rates of growth and sedimentation were achieved. (Author's abstract)
W85-06663

HYDROCHEMICAL RESULTS OF THE TREATMENT OF HEAVILY LOADED SURFACE WATER AND BANK FILTRATION WITH HYDRATED LIME. PART 2 (HYDROCHEMISCHE ERGEBNISSE ZUR AUFBEREITUNG STARK BELASTETER OBERFLACHENWASSER UND UFERFILTRATE MIT KALKHYDRAT. TEIL 2),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
L. Bohm.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 2, p 223-233, 1983. 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Water treatment, *Filtration, *Hydrated lime, Surface waters, Humic acid, Lignosulfonic acid, Chemical treatment, Precipitants, Metallic salts, Flocculation, Aluminum, Magnesium.

Continuing the first part on this subject, the results of precipitation experiments are described by the example of the removal of humic acid and lignosulfonic acid. Moreover, to increase the number of process variants and in accordance with process methods after Haberer, a two-stage chemical treatment, inter alia, is proposed. According to the latest findings, a metallic salt dosing should be done at the first stage so that the purification effect can be improved. This new technique, termed 'combination stage flocculation', is based on new findings concerning the solubility behavior of aluminum compounds at higher pH-values in the presence of magnesium salts, when slightly soluble aluminum-magnesium double hydroxides originate. (Author's abstract)
W85-06664

TRIHALOMETHANES IN GROUNDWATER SYSTEMS,
Howard Univ., Washington, DC. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-06696

USE OF HISTORICAL DATA FOR ESTIMATING THE NUMBER OF SAMPLES REQUIRED FOR MONITORING DRINKING WATER,
National Water Research Inst., Burlington (Ontario).
A. H. El-Shaarawi, J. C. Block, and A. Maul.
Science of the Total Environment, Vol. 42, No. 3, p 289-303, April, 1985. 4 Fig, 4 Tab, 7 Ref.

Descriptors: *Drinking water, *Water quality management, *Bacteria, *Monitoring programs, Dispersion, Model studies, Data interpretation, Water sampling.

Statistical techniques were reviewed for estimating the number of samples required to monitor the quality of drinking water when the dispersion of bacteria in the water can be modeled by the Poisson or the negative binomial distributions. The concept of the operating characteristic (OC) curve of the water distribution system was used to evaluate the risk of declaring that the bacteriological water quality regulation is met when only a small portion of the water is analyzed. Assuming that the regulation requires that the monthly mean bacterial counts for samples of standard volume are to be less than one per ml, the OC curves are compared for different sample sizes and for different values of the parameters of the negative binomial. The results indicate that the correct specification of the model is very important in evaluating the risk of sampling (i.e. making the wrong decision). Total bacterial counts based on 1-ml samples, from the cities of Nancy and Metz in France, support the use of the negative binomial as a model for the dispersion of bacteria in drinking water. In the few cases where the negative binomial did not fit the data, the lack of fit can be attributed to the greater occurrence of the frequency of finding only one bacterium in the sample than that expected for the negative binomial. The OC curve indicated that the present monitoring strategy for the city of Nancy is adequate for monitoring the water quality if (i) the regulation requires that the monthly mean of total bacterial counts should not exceed one bacterium per ml, and (ii) the probability of accepting that the water quality is meeting the regulation, when the true mean number of bacteria per ml is two, should not be larger than 0.05. On the other hand, the city of Metz data indicated that it is necessary to increase the intensity of sampling both in time and space in order to achieve the same level of adequacy as that of the city of Nancy. (Author's abstract)
W85-06703

CORROSION IN THE SWISS DRINKING WATER DISTRIBUTIONS SYSTEMS,
Sulzer Bros. Ltd., Winterthur (Switzerland). Water and Wastewater Engineering Div.
J. C. Ginocchio.
European Water and Sewage, Vol. 88, No. 1063, p 389-393, September, 1984. 11 Fig.

Descriptors: *Corrosion, *Water conveyance, *Drinking water, *Switzerland, Corrosion control, Pipes, Water treatment, Chemical treatment, Aeration.

Corrosion in the water distribution systems of several Swiss towns and villages not only damages the iron pipes, but impairs the quality of the drinking water. The corrosion is due primarily to: soft ground water with a relatively high concentration of free carbon dioxide; water with a negative Langelier index; a low concentration of dissolved oxygen as well as the sporadic presence of hydrogen sulfide; water stagnation; acidification of the water due to purification. The proper techniques for treating water to prevent corrosion are discussed, including: deacidification; aeration; monitoring to control the addition of chemicals; and passing the water through a filter containing treated calcium carbonate. (Cutty-IVI)

W85-06810

EXPERIMENTS IN COLOUR REMOVAL FROM SURFACE WATER BY MEANS OF THE OFSY SYSTEM,
L. Coccagna.
European Water and Sewage, Vol. 89, No. 1067, p 38-39, January, 1985. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Surface water, *Water treatment, *Color removal, *OFSY system, Drinking water, Acidity, Disinfection, Turbidity, Trihalomethanes, Filtration.

The application of a number of theoretical findings has made it possible to confirm that color is removed from surface water by a high velocity direct filtration system. In relation to the duration of the filtration cycle, the quantity of the color to be removed is more critical than the turbidity which may be present. This fact can be ascribed to a higher dose of alum required, which causes the formation of a floc of poor physical resistance. The Omnifiltration System (OFSY) is described in which two in-series filters with three layers of filtering mineral and two layers of mineral serve as underdrain. This arrangement affords a higher performance than that provided by a mere combination of filters. The in-series layout of the filters allows a longer duration of the cycle as compared to that achieved with conventional single filtration. The duration of the cycle is 4 to 5 times as long, thus providing more time for color removal to occur. The pH value is the conclusive factor in the quality of the results. The optimum pH range does not always match exactly the goals set. The injection of a filter aid before the second filter of the series is essential as it contributes to holding the leakage from the first filter by forming flocs which resist detachment forces. Direct filtration makes it possible to achieve a considerable saving in chemicals. In general direct filtration can make a great contribution to preventing the formation of halogenated compounds. It can also be an alternative to more complex, bulky and expensive equipment for water treatment. (Baker-IVI)
W85-06813

TRENDS IN DRINKING WATER TREATMENT: THE SHAPE OF THINGS TO COME; PART II - NEW DEVELOPMENTS IN WATER TREATMENT,
Metcalf and Eddy of New York, NY.
G. P. Fulton.
Public Works, Vol. 116, No. 5, p 56-60, May, 1985. 1 Tab, 3 Fig.

Descriptors: *Water treatment, *Drinking water, Chlorination, Ozonation, Flocculation, Filtration, Adsorption, Disinfection, Chemical treatment, Sedimentation.

This paper reviews past and present techniques and chemicals used for drinking water treatment. The principal drinking water tratment unit processes are air stripping oxidation, coagulation/flocculation, settling, flotation and entrapment. The chemicals used are chlorine, chloramines, chlorine dioxide, ozone, alum and polymers. Alum usage in coagulation/flocculation units has decreased drastically with the co-use of either polymers and/or ozone. Higher energy in mixing produces a flow with superior separation characteristics and requires much less installation space. Plastic tube settlers or lamella plate settlers both operate by the phenomena of layered settling and both operate at better than three times the overflow rate of conventional settlers. Flotation by air bubbling is an efficient method to remove suspended matter of algal or plant origin. Entrapment may either be by granular filtration, DE filtration or granular activated carbon adsorption, and the technique of choice is determined by discrete particle removal, operation flexibility, space requirement, and capital and operating costs. Chlorine, the traditional drinking water disinfectant, is now being phased out due to the production of trihalomethanes, a loss of potential carcinogens. Ozone is a very active disinfectant that has a very short life cycle with reactions best accomplished under pressure or in a short detention device. (Cutty-IVI)

W85-06835

TECHNICAL SUPPORT PACKAGE ON SOLAR-POWERED WATER DISTILLATION,
Jet Propulsion Lab., Pasadena, CA.
F. J. Menninger, and R. J. Elder.
JPL Invention Report NPO-15894/5353, Spring 1984. 4 p, 3 Fig.

Descriptors: *Water treatment, *Distillation, *Solar distillation.

A solar still was designed to deliver pure water for cooling the klystron tube at the Venus station of the Deep Space Network Tracking Complex, Goldstone, California. It is composed of eight 1.85 sq m fiberglass solar still panels, which provide 6000 gal of water per year. The once-per-day flush and fill functions are automatic. The gravity feed system, using well water with high mineral content, is expected to save $5000 per year on operating costs and pay back its $24,000 costs within 3.5 years.
W85-06916

SMALL COMMUNITY WATER SUPPLIES: TECHNOLOGY OF SMALL WATER SUPPLY SYSTEMS IN DEVELOPING COUNTRIES.
International Reference Centre for Community Water Supply and Sanitation, The Hague (Netherlands).
John Wiley and Sons, New York, 1981. 442 p. Edited by E. H. Hofkes.

Descriptors: *Water supply, *Water treatment, *Water distribution, *Developing countries, Rural areas, Public health, Planning, Water management, Water resources development, Water quality, Water harvesting, Springs, Surface water, Groundwater, Water use, Water requirements, Water demand, Catchment basins, Water storage, Cisterns, Water tanks, Groundwater mining, Ditches, Dug wells, Tube wells, Shallow wells, Recharge, Artifical recharge, Groundwater recharge, Bank infiltration, Infiltration, Pumps, Chlorination, Reservoirs, Aeration, Coagulation, Flocculation, Sedimentation, Filtration, Disinfection, Conduits.

This handbook is an introduction to the technology of small community water supplies, especially in developing countries. It is directed to readers with some technical background in engineering, public health, or irrigation, but with no formal training or experience in water supply. Planning and management include supervision, training, community involvement, maintenance, and emergency operation. Guidelines for water requirements and quality are given. Types of water sources and their selection are described. These include rainwater harvesting in roof and ground catchments, tapping of gravity and artesian springs, groundwater withdrawal by different techniques (infiltration galleries, dug wells, tubewells), and surface water intake from rivers and lakes. Aquifer recharge can be accomplished by bank infiltration, spreading water on permeable surfaces, or sand fill dams. Pumping includes power sources, types of pumps (reciprocating, rotary, axial-flow, centrifugal, and air lift). Water treatment processes appropriate for small systems are aeration (waterfall and bubble), coagulation and flocculation, sedimentation in settling tanks and tilted plate or tube settlers, slow sand filtration, rapid filtration, and disinfection (physical or chemical). Canals, aqueducts, tunnels, pipelines, and pumping can be used to transmit water. Water distribution systems should be simple, either branched or looped. Service connections may be in the house, in the yard, or at a public standpipe. Design considerations for storage reservoirs, pumping stations, and the system as a whole are given. Appendixes cover sanitary survey, well drilling, water treatment plant design, and chemicals.
W85-06930

OPTIMIZATION OF BIOLOGICAL RECYCLING OF PLANT NUTRIENTS IN LIVESTOCK WASTE BY UTILIZING WASTE HEAT FROM COOLING WATER,
Tennessee Valley Authority, Muscle Shoals, AL. Div. of Agricultural Development.
For primary bibliographic entry see Field 5D.
W85-06983

CONSIDERATIONS INVOLVED IN THE REACTIVATION OF AN EXISTING WATER SUPPLY,
Massachusetts Metropolitan District Commission, Southborough. Water Div.
W. A. Brutsch, and S. L. Bishop.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 1-25, March, 1985. 10 Fig, 1 Tab.

Descriptors: *Water treatment, *Sudbury Reservoir, *Boston, *Massachusetts, Filtration, Oxidation, Ozonation, Clarification, Pilot plants, Water supply development, Hydraulic pulsed upflow, Activated carbon.

The Metropolitan District Commission (MDC) water system serves about 2.5 million people in 45 communities from Chicopee to Boston, Massachusetts. The Sudbury watershed, consisting of 75.2 sq mi, is not included in the MDC calculation of system safe yield since it can not function as an ongoing source without additional water treatment. A pilot plant testing program was undertaken to investigate alternative treatment processes for water from the Sudbury Reservoir. The hydraulic pulsed upflow clarification-filtration system produced water of an acceptable quality at a filtration rate twice that of the ozonation-filtration system. In general the hydraulic pulsed upflow clarification-filtration system was affected less by changes in color, turbidity, and algae than the ozonation-filtration system. The hydraulic pulsed upflow clarification-filtration system exhibited life cycle costs 76% of the ozonation-filtration system. The construction cost of the hydraulic pulsed upflow clarification-filtration system was estimated to be 87% of the ozonation-filtration system. As a result of these comparisons, the hydraulic pulsed upflow clarification-filtration system with granular activated carbon filters was recommended for treating water from the Sudbury Reservoir. (Baker-IVI)
W85-07056

PURIFYING OUR NEW ENGLAND DRINKING WATERS,
Camp, Dresser and McKee, Inc., Boston, MA.
P. W. Prendiville.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 26-38, March, 1985. 3 Fig.

Descriptors: *Drinking water, *New England, *Purification, Water treatment, Disinfection, Coagulation, Filtration, Carcinogens, Organic compounds.

Direct filtration and conventional treatment facilities are the core of today's water purification plants. In some cases, however, natural and synthetic organic matter can be present in the waters. Traditional treatment methods can be adjusted to remove some of this matter, but usually not enough of it to be safe. In addition to traditional processes like screening, coagulation, sedimentation and filtration, processes such as storage, aeration, oxidation, micro-flocculation with ozone and adsorption of organics on activated carbon can be applied economically. Five steps have been devised to arrive at the best conceptual design for treating a water supply: examine water quality records, run pilot and plant scale tests, research the literature, talk to experts and visit plants, and run alternative designs through conceptual design/cost alternates and conduct discussion and review meetings. Operational/maintenance problems which should be designed against are briefly discussed. Those designing the system must work closely with the operator, share experiences and in that way design a plant that will not only be pleasant to work in but that will produce a quality drinking water. (Baker-IVI)
W85-07057

REBUILDING WATER SUPPLY INFRASTRUCTURE,
Massachusetts Dept. of Environmental Quality Engineering, Boston.
M. I. Bhatti.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 39-45, March, 1985. 4 Ref.

Descriptors: *Water supply development, *Infrastructure, *Planning, *Massachusetts, Decision making, Financial aspects, Maintenance.

The term infrastructure is frequently used when discussing problems resulting from a lack of planned maintenance of the nation's physical stock. It appears that we are now urgently being called upon to pay the bills for the deferred maintenance of structures which were built with professional ingenuity and pride decades ago. A history is offered of various programs in Massachusetts including the grants program, the leak detection, and the rehabilitation program. In spite of the national emphasis on the need to rebuild the nation's infrastructure, water infrastructure does not appear to be accorded the priority it deserves. Innovative ways of financing will have to be explored at local, state and federal levels to commit financial resources on a long term basis to solve the problems. In the end, the most important goal should be the establishment of the true cost of water. State funds or federal funds can only provide financial assistance on a short term or temporary basis. Water utilities must take steps to establish self-sustaining systems. In the absence of that the infrastructure problem could only get worse. (Baker-IVI)
W85-07058

WATER SYSTEM OPERATION AND MAINTENANCE UTILIZING PUBLIC SECTOR EMPLOYEES AND PRIVATE SERVICE CONTRACTORS,
Cambridge Water Dept., MA.
J. J. Cussack.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 48-52, March, 1985.

Descriptors: *Cambridge Water Department, *Massachusetts, *Water conveyance, *Water distribution, Drinking water, Water treatment, Utilities, Maintenance.

The Cambridge Water Department (CWD) is a municipally owned and operated water utility serving about 100,000 permanent customers and an estimated additional 25,000 student population during the academic year. The principal assets of the CWD include three surface water reservoirs, a 24 mil gal/day water treatment plant, a 43 million gallon elevated distribution/storage reservoir, and about 175 miles of distribution and transmission mains, ranging in size from 4 in cast iron to 40 in steel. The Department is organized into three major operating divisions defined as Water Resources, Distribution and Transmission, and Treatment and Pumping. Each of these operating divisions has its own set of assets and liabilities which require customized programs for operation and maintenance. The CWD is presently utilizing a combination of public sector employees and private sector service contractors to perform operation and maintenance work on the Cambridge Water System. (Baker-IVI)
W85-07059

TRADITIONAL APPROACH TO WATER SYSTEM O AND M,
Manchester Water Works, NH.
D. Kittredge.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 53-61, March, 1985. 3 Fig, 1 Tab.

Descriptors: *Operation, *Maintenance, *Water conveyance, *Manchester, *New Hampshire, Planning, Drinking water, Water supply development, Water treatment, Watershed management.

Operation and maintenance techniques are described for the 40 mgd capacity water filtration plant located at Lake Massabesic, New Hampshire. This plant uses both conventional and non-conventional treatment processes including coagulation, settling, sand filtration and carbon filtration. A staff of ten fulltime operators operate and maintain all aspects of the facility including a 6 ton per day capacity carbon regeneration system plus one local and three remote pumping stations. All operators, including the plant manager-chemist are licensed to operate the treatment facility. A planned approach to routine operation and maintenance is followed by the plant supervisory staff with close follow-up to ensure completion of assigned tasks. Another major area of planned maintenance is that which occurs on the MWW's watershed land of over 8,000 acres plus its three covered distribution reservoirs. All this work is accomplished by a fulltime labor force of five men plus three part time summer laborers under the direct supervision of the Watershed Forester. Operation and maintenance of the water distribution system at Manchester is presently accomplished by 36 fulltime employees including a registered professional engineer who serves as general manager of the distribution division along with three principal supervisory staff employees. (Baker-IVI)
W85-07060

CONTRACT OPERATIONS - ONE ALTERNATIVE FOR WATER TREATMENT FACILITIES,
Metcalf and Eddy, Inc., Boston, MA.
W. Peterson.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 62-71, March, 1985.

Descriptors: *Water management, *Operation, *Maintenance, Decision making, Planning, Water treatment facilities, Contract operations.

Contract operation of water treatment facilities refers to the operation of a publicly owned facility by a private firm under contract to the municipal owners. Contract operation of wastewater treatment plants is expected to go from a $50 million per year business and industry to a $200 million annually business in 1990. Contract operation is characterized by a business-like entrepreneurial private sector approach to operating, maintaining, and managing water treatment facilities. The benefits of such an arrangement, the uniqueness of private sector operation and maintenance, and some examples of communities where this type of arrangement is working are considered. (Baker-IVI)
W85-07061

EMERGENCY: INTRUSION OF PROPANE INTO WATER MAINS,
Bridgeport Hydraulic Co., CT.
R. C. Smedberg.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 82-89, March, 1985.

Descriptors: *Trumbull, *Connecticut, *Water conveyance, *Accidents, *Propane, Water pollution sources, Hazardous materials, Emergency procedures, Hazards, Safety, Regulations.

Emergency plans of the Bridgeport Hydraulic Company (BHC) were put into effect in response to an incident of propane gas intrusion into a section of its distribution system, in Trumbull, Connecticut. At a propane plant in the area, one tank was being purged using water taken from a private hydrant through a 1.5 inch hose connected to the inlet of the tank, in violation of state and company rules. The initial phase of BHC's involvement was to identify the affected area and isolate the water mains in that area to contain the problem. Distribution crews began monitoring hydrants and air vents at strategic locations outside the area to ascertain that the problem was contained. One hydrant outside the initial containment area was found to be contaminated. Additional valves were shut. Homes and businesses were evacuated and electric power was shut off to the area. The water mains were filled and vented to drive out the propane. Teams went house-to-house in a systematic order, to restore individual water and gas service, check and vent each water using device and/or system, and relight gas pilots. The last phase involved a continuous flushing and sampling program within the area to monitor water quality to ensure the concentrations of propane in the water were reduced below the no health effects threshold level. Estimates indicated that propane was introduced in gaseous form over an approximate 20 minute period, and that as much as 750 C.F. was introduced into the water mains. (Baker-IVI)
W85-07063

EVALUATION OF CORROSION CONTROL INDICES FOR NEW ENGLAND WATERS,
J. J. Collins.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 90-95, March, 1985.

Descriptors: *Water quality, *Water treatment, *Corrosion control, Acidity, Langelier Index, Ryznar Index, Drinking water, Hydrogen ion concentration, Hardness, Buffering.

Highlights of the NEWWA Committee No. 55 report on Corrosion and Its Effects on Water Quality are presented. In particular an attempt is made to explain pHs (pH of saturation with respect to calcium carbonate), Langelier Index (LI), Ryznar Index (RI), and Aggressive Index (AI). Means of calculating each of these indexes are provided and a study of corrosion in Seattle, Washington is reviewed. The Seattle supply comes from two mountain rivers, resulting from rainfall and snowmelt runoff and thus is very soft and tends to be highly corrosive. Treatment given to these water sources is to add lime and sodium carbonate to the Tolt supply to attain the pH of the Cedar River supply and provide a fixed pH of 8.3. Because of the poor buffering capacity in the pH 8.0 to 8.5 range, it is advisable that open distribution reservoirs be covered to prevent carbon dioxide gain or loss which would affect maintenance of proper pH. (Baker-IVI)
W85-07064

INTERFACE BETWEEN FILTRATION AND BACKWASHING,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah.
Water Research, Vol. 19, No. 5, p 581-588, 1985. 11 Fig, 13 Ref. NSF grant ISP-80411449.

Descriptors: *Water treatment, *Filtration, *Backwashing, Water quality control, Degradation, Model studies, Filters, Mathematical models.

The initial quality of effluent from a granular media filter that has been used for several runs is usually poor. A conceptual model of the initial degradation phase of filtration is presented as an interface effect between backwashing and filtration. The initial degradation of effluent quality is due to the backwash water remnants within the media and the backwash water above the media. The two peak characteristics of initial degradation due to the backwash water remnants within the media and above the media is established by an extensive experimental investigation. A mathematical model for the quality of backwash water as a function of backwash water volume is developed. The concentration of particles in the backwash water remnant above the media varies as an exponential function with backwash water volume. The highest concentration of detached particles would therefore be at the top of the backwash remnant above the media. Filtration efficiency would be an inverse function of filtration rate at the initial stages of filtration, when all other parameters remain unchanged. This would imply that the magnitude of the second peak in initial degradation would be a direct function of filtration rate. (Baker-IVI)
W85-07117

EFFECT OF TEMPERATURE, PH, AND OXYGEN LEVEL ON THE MULTIPLICATION OF NATURALLY OCCURRING LEGIONELLA PNEUMOPHILA IN POTABLE WATER,
Pittsburgh Univ., PA. Graduate School of Public Health.
For primary bibliographic entry see Field 5B.

W85-07128

USE OF BITUMINOUS COAL AS AN ALTERNATIVE TECHNIQUE FOR FIELD CONCENTRATION OF WATERBORNE VIRUSES,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Virology Section.
For primary bibliographic entry see Field 5A.
W85-07129

5G. Water Quality Control

MOISTURE SENSOR-CONTROLLED IRRIGATION FOR REDUCING N LEACHING IN BERMUDAGRASS TURF,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
G. H. Snyder, B. J. Augustin, and J. M. Davidson.
Agronomy Journal, Vol. 76, p 964-969, November-December, 1984. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Irrigation, *Nitrogen, *Grasses, *Bermudagrass, Plant growth, Leaching, Nutrients, Water pollution control, Sensor irrigation.

Turfgrass N fertilization may contribute to concentrations of NO3-N in groundwater. The feasibility of using a tensiometer-controlled irrigation system to reduce N leaching in turf grass while maintaining acceptable growth was determined. Bermudagrass was grown on a sand soil during a series of 2 month cycles. Irrigation was applied either daily or when permitted by tensiometer soil moisture sensors. Nitrogen at the rate of 5 g/sq m/month was applied bimonthly as NH4NO3 or sulfur coated urea or NH4NO3 through the irrigation system with each irrigation. Nitrogen leaching ranged from 56% to less than 1% of that applied, depending on treatment and cycle. Greatest N losses occurred with NH4NO3 combined with daily irrigation. Smallest losses were noted when NH4NO3 was applied through the irrigation system with each irrigation and these irrigations occurring only when the sensor indicated it was appropriate. Sensor irrigation reduced N leaching from all N sources. Acceptable turfgrass growth and quality were maintained under these conditions. (Baker-IVI)
W85-06187

EVALUATING THE OPTIONS FOR WATER QUALITY MANAGEMENT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. Cairns, Jr.
Water Resources Bulletin, Vol. 21, No. 1, p 1-6, February, 1985. 22 Ref.

Descriptors: *Water quality management, *Waste disposal, *Environmental effects, *Legislation, Water quality standards, Water quality control, Toxicity, Monitoring.

The agricultural revolution occurred because the unmanaged environment was not providing food in either the quantity or quality that society desired. The 'environmental revolution' is developing because the unmanaged environment is clearly not capable of assimilating societal wastes without being seriously degraded. Effective environmental management will require regional and site-specific modification of general principles and practices that can be used at a national or international level. An environmental management system can be operated in the same manner as any industrial quality control system with three basic components: (a) sensors at appropriate locations, (b) rapid generation and feedback of information, and (c) a quality control group capable of taking immediate effective action when system performance is outside predetermined boundary conditions. This discussion focuses primarily on three areas: (a) management options available to regulate intrusion of societal wastes into natural systems, (b) types of methods available for predicting and validating effects on natural systems, and (c) modifications of present legislation that would permit the most flexibility in selecting from the various management options. Also considered are multispecies toxicity tests using species with cosmopolitan distribution in test systems with a high degree of environmental realism. Among the many values of such tests is the ability to exchange information from all parts of the world effectively because the test organisms are not restricted to a particular geographic region. (Author's abstract)
W85-06232

COMPARATIVE BASES OF INDUSTRY POLLUTION ABATEMENT AND COMMERCIAL INNOVATION: IMPLICATIONS FOR WATER RESOURCES MANAGEMENT,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
R. E. Rickson, and C. E. Ramsey.
Water Resources Bulletin, Vol. 21, No. 1, p 89-97, February, 1985. 2 Tab, 33 Ref.

Descriptors: *Water pollution control, *Industrial wastes, *Water resources management, Regulations, Attitudes, Innovation, Water pollution prevention.

Adoption, maintenance, and operation of pollution control technology by manufacturing firms is essential to effective water resource management. In this study of 102 industries, it is found that company adoption of pollution control technology and practices is primarily associated with two factors: (1) the overall company capacity for innovation in its production technology; and (2) company relationships with state and federal pollution control agencies, local government officials and professionals. Managerial attitudes about pollution and government regulation are not associated with either pollution control or commercial innovation, but are seen as basic to industry-government relationships. The data suggest an important regulatory dilemma, the problem of regulating a large number of small companies with a low capacity for innovation, but which when taken together account for large volumes of toxic effluent. (Author's abstract)
W85-06243

BIOINDICATION FOR THE DECREASE IN NITROGEN LOSS AND NITROGEN POLLUTION OF THE WATERS (BIOINDIKATION ZUR VERMINDERUNG VON STICKSTOFFDUNGERVERLUSTEN UND DER STICKSTOFFBELASTUNG VON GEWASSERN),
Akademie der Landwirtschaftswissenschaften der DDR, Halle/Saale. Inst. fuer Landschaftsforschung und Naturschutz.
U. Wegener.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 279-293, 1983. 5 Fig, 27 Ref.

Descriptors: *Water pollution control, *Nitrates, *Fertilizers, *Bioindicators, Leaching, Optimization, Water pollution sources, Agricultural chemicals, Climate, Temperature.

Prerequisite to the control of nitrogen leaching from agricultural soils in spring is the ecologically optimum control of the first nitrogen fertilizer application. On the basis of investigations carried out for some years, a method for determining the optimum time of fertilization with the aid of phenological data is presented. The blossoming data of Anemone nemorosa proved to be a suitable sensitive indicator; the onset of blossoming is the optimum time for the first nitrogen application. Depending on the altitude and variation of weather, in the temperate mountains this time is 90 to 116 d after the beginning of the year and corresponds to a temperature total > or = 5 C of 80-120 C or > 0 C: 160-230 C. Possibly, the leaf development of Alchemilla vulgaris or the first development of Poa pratensis are suitable as other bioindicators. The boundary conditions and disturbance variables of the bioindication are discussed. By the phenological date-determination of the beginning of fertilization the nitrogen losses can be reduced by 10 to 20% and the nitrate leaching can be considerably reduced especially in drinking-water protection areas. (Author's abstract)
W85-06260

METHOD FOR NITRATE ELIMINATION IN WATERS (VERFAHREN ZUR NITRATELIMINIERUNG IM GEWASSER),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
N. Fichtner.
Acta Hydrochimica et Hydrobiologica, Vol. 11, No. 3, p 339-345, 1983. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Nitrates, *Nitrogen removal, *Hypolimnion, *Fatty acids, Anaerobic conditions, Water quality control, Storage reservoirs, Iron, Phosphorus, Manganese.

In a storage reservoir with a hypolimnic volume of 3.5 cu hm the water contains 40 mg/l nitrate. A straw bale of 60 by 20 by 1.5 m was introduced as a reactor. Hypolimnic water polluted with a waste product of fatty acid syntheses (30-20% formic, acetic, propionic, butyric and valeric acids) was pumped through it. By the use of a total of 43.8 t fatty acid mixture from June to August an additional oxygen depletion of 14 t O2 is achieved and 49 t NO3(-) are removed at the same time. The ammonium concentration did not increase; the NO2(-) concentration, however, rose to 12-13 mg/l NO2 at times. The fatty acids were used up except 0.1 mg/l. The increase in the NO2(-) concentration, in the number of microorganisms and in the iron, manganese and phosphorus resolution due to the controlled anaerobic conditions is the drawback of the process. (Author's abstract)
W85-06264

MATHEMATICAL REPRESENTATION OF SHORT TERM PHOSPHORUS VARIATIONS IN A NON-STRATIFIED SOUTHERN LAKE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W85-06285

NONPOINT SOURCE POLLUTION ABATEMENT IN THE GREAT LAKES BASIN/AN OVERVIEW OF POST-PLUARG DEVELOPMENTS,
International Joint Commission-United States and Canada, Windsor (Ontario).
Report to the Great Lakes Water Quality Board, August 1983, 96 p, 4 Fig, 6 Tab, 4 Append.

Descriptors: *Lakes, *Land use, *Nonpoint pollution sources, *Soil conservation, *Interagency cooperation, *Jurisdiction, *Pollution load, Chemical wastes, Agricultural runoff, Agricultural chemicals, Soil erosion, Economic aspects, Planning.

In 1972, the Pollution From Land Use Reference Group (PLUARG), a subgroup of the International Joint Commission (IJC), was established to determine the causes and levels of pollution from land use activities and to recommend appropriate remedial actions. PLUARG made its initial report in 1978. This report summarizes the effects of nonpoint pollution control in subsequent years. The need for nonpoint source control programs has increased during the period due to the intensifying use of farmland which increases soil erosion. Cash grain and monoculture crops have been replacing the more comprehensive operations that were the norm in the 1940s. This has been accompanied by an increasing reliance by farmers on complex technology, including elaborate equipment and greatly increased use of chemicals. In Canada, no action has been taken to develop a comprehensive program to address nonpoint sources of water pollution in the Great Lakes basin, although the level of expenditure on basin studies has averaged about $1.5 to $2 million per year since 1980. To date the Thames River Implementation Committee program has been one of the most successful in Ontario. As a result of the program, which encourages better land use practices, more farmers have begun using soil conservation practices. In the U.S., there is no comprehensive program for the control of nonpoint sources of pollution. There are large-scale soil conservation programs, however, they are not primarily focused on water quality. (Hawkins-Omniplan)
W85-06341

AERATION-DESTRATIFICATION OF LAKE EUREKA: SECOND YEAR OPERATION,
Illinois State Water Survey Div., Champaign.
R. K. Raman, and R. L. Evans.
ISWS Circular 159, 1984, 25 p, 13 Fig, 6 Tab, 3 Ref, 2 Append.

Descriptors: *Destratification, *Aeration, *Aerated lagoons, *Aerators, *Chemical treatment, *Lake restoration, *Lake rehabilitation, *Political aspects, *Water management, *Taste, *Odor control, Algae, Algae control, Water treatment, Lake Eureka, Illinois.

In response to taste and odor problems at Lake Eureka in Eureka, IL, an in-lake water quality management program was instituted in 1981 that included aeration-destratification in combination with in-lake chemical control of algae. The results are presented of the second-year operation of the destratification device. Factors in the lake that had been identified as causing taste and odor problems in the finished waters (such as high levels of iron, manganese, ammonia, and chlorine demand values; anoxic conditions in the deep waters; and blue-green algae dominance) were reduced or altered improving the lake water quality characteristics. The city of Eureka reverted to the lake from groundwater as its source of water supply in April 1982. With the aerator in place and with two chemical applications to control the blue-green algae during the summer months of 1982, the water treatment system functioned extremely satisfactorily without any source-related consumer complaints about taste or odor. Percentage reduction of 91, 94, 98 and 55 in the mean values of ammonia-nitrogen, iron, manganese and chlorine demand were achieved during 1982. Blue-green algae were never dominant in the lake. The lake water quality management scheme thus resulted in a savings of $40,000, or 43.6% of the operating cost in FY 1981-82. (Hawkins-Omniplan)
W85-06344

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, EXECUTIVE SUMMARY,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-A, June 1983. 13 p, 2 Tab, 1 Fig.

Descriptors: Surface water, River basins, *Monitoring, Trophic level, *Nonpoint pollution sources, *Toxicity, Eutrophication, Estuaries, Watersheds, Water pollution effects, Surface water records, Bays, Phosphorus, Water pollution, Coliforms, *New Jersey, *Water quality.

This report, a complete revision of a State Water Quality Inventory Report of 1977, reviews surface water in New Jersey from 1977 to 1981, using ambient monitoring data collected at 78 fixed stations. The ability of the state's waters to meet the swimmable and fishable goals of the Clean Water Act are discussed. It was found that surface water qualtiy throughout the state has been relatively stable over the last four to five years, while coastal bays and estuaries improved significantly. Water quality degradation occurred in the Passaic, Raritan and Hackensack River basins during a 1980-1981 drought. It was found that nutrient enrichment is a major problem in the state's waterways, with 45 percent of all total phosphorus values exceeding criteria. A large number of lakes in the state are considered eutrophic. For other water quality indices, four percent of the DO values fell below standards, while three percent of un-ionized ammonia two percent of total dissolved solids values exceeded their standards. The majority of fecal coliform samples were greater than the 200 MPN/100 ml criterion. New Jersey has approximately 1,600 permitted point source wastewater discharges, and many possible nonpoint sources of pollution. Toxic substances seemed to be fairly widespread at very low concentrations. Major recommendations for water quality improvement include coordinated watershed management activities, greater identification of nonpoint sources, and protection of groundwater levels and quality. (Hawkins-Omniplan)
W85-06348

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-B, June 1983. 195 p, 26 Tab, 16 Fig, 38 Ref, 3 Append.

Descriptors: Surface water, Groundwater basins, Rivers, *Water pollution sources, Phosphorus, Coliforms, *On-site data collections, *Toxicity, Streams, Water use, Water pollution effects, *New Jersey, *Water quality.

Water quality changes in New Jersey as the result of water pollution control efforts during the past decade are reviewed, and what improvements may be needed are suggested. There is a rating system of surface waters based on water quality conditions and water used, including potable water diversions, bathing beaches, fisheries, resources and agricultural water use. Each of these two indices is comprised of a number of parameters used to measure water quality and water uses in the 29 river basin segments studied. Toxic substances were examined in the water column, bottom sediments and fish tissues, and point scores were given for each medium examined, for a total of 100.0 if toxics were found in all three. The segments found to have the greatest water quality impairment were the Mid-Passaic, Lower Raritan Mid-Passaic tributaries and the South Branch Raritan, with water quality indexes of 146, 103, 98 and 85, respectively. The majority of New Jersey's inland surface waters do not meet minimum standards for swimming and are not expected to meet the national swimmable goal in the foreseeable future. Recommendations for improvement include increased monitoring, greater identification of surface water uses and resources, coordinated watershed management activities, identification and control of nonpoint pollution sources, and achieving effluent quality from point sources. Common ambient quality problems requiring treatment are high iron, high dissolved solids content, high manganese content, acidity, alkalinity, and hardness. (Hawkins-Omniplan)
W85-06349

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, APPENDIX--DELAWARE RIVER BASIN,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-C: 1.A, June 1983. 233 p, 3 Tab, 160 Fig, 11 Ref.

Descriptors: *River basins, Coliforms, *Water pollution sources, *Forest watersheds, Phosphorus, Dissolved oxygen, Natural streams, Watersheds, Groundwater basins, Large watersheds, Drainage area, On-site data collections, Rivers, *New Jersey, Water quality, *Delaware River basin.

Twelve river basins of the Delaware River are reviewed interms of water quality, problem assessment, and goal assessments and recommendations. Each basin is described, according to identified water uses, monitored swimming locations, fishing opportunities and resources, shellfish harvesting, and other specific uses unique to the region. Monitoring programs indicate that surface water quality within the Walkill River basin is marginal. Contravention of the fecal coliform 200 MPN/100 ml standard are frequent throughout the basin. Flat Brook is categorized as one of New Jersey's highest quality streams, with only one recorded DO concentration value recorded below 7.0 mg/l. Paulins Kill's watershed, which contains a variety of land uses, has normally high quality water with occasional concentrations approaching or exceeding applicable criteria. The Pequest River watershed is 58% forested, and the Musconetcong River watershed has areas of significant development, yet the surface waters of both are of overall good quality but exhibit excessive levels of fecal coliform and total phosphorus to varying degrees. At Pohatcong and Lopatcong Creeks, water quality was found to be generally good, although total phosphorus and fecal coliform concentrations were often found to be excessive. Seasonal low flow periods appeared to cause occasional adverse imapcts on 12 other tributaries to the Delaware River, and elevated fecal coliform concentrations indicated possible problems. Also discussed are Assunpink, Crosswicks, Assiscunk, Rancocas, Pennsauken, Woodbury, Mantua, Raccoon, Alloway, Big Timber and Oldmans Creeks, and four rivers. (Hawkins-Omniplan)
W85-06350

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, APPENDIX--ATLANTIC COASTAL BASIN,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-C: 1.B, June 1983. 103 p, 1 Tab, 60 Fig.

Descriptors: Parametric hydrology, Urban watersheds, Storm runoff, Groundwater basins, *Large watersheds, *Water pollution sources, Dissolved oxygen, Anaerobic conditions, Drainage area, Catchment areas, Watersheds, Buffering, *New Jersey, Water quality, *Atlantic Coastal basin.

Six watersheds of the Atlantic Coastal Basin area of New Jersey are described, using a segment analysis and graphs showing all raw data points collected for ten parameters. In the southern section, which includes a multimillion dollar casino/resort industry, water quality was generally good, with dissolved oxygen and biochemical oxygen demand concentrations at acceptable levels annually. Some contamination sources need to be studied further, and long-term and year-round monitoring stations prevent specific conclusions from being made. At Great Egg Harbor River, the upper watershed is in greatest need of improvement using advanced treatment and removal rates or alternative wastewater disposal practices at the Berlin Borough Treatment Plant. The Mullica River watershed is predominantly undeveloped state park and forests, where water quality is generally good although some occasional extreme values were exhibited during summer low flow conditions. In the Mid-Atlantic region, where there are more than 50 lakes, high trihalomethane levels were found, and stream water quality varied from generally good to marginal. Advanced treatment methods are recommended because of the low buffering capacity of the inland streams. The Manasquan River water quality was marginal at best, and one recommendation is the correction of malfunctioning septic systems. In the northern region, water quality was generally good, but stormwater runoff controls are probably needed. (Hawkings-Omniplan)
W85-06351

NEW JERSEY 1982 STATE WATER QUALITY INVENTORY REPORT, APPENDIX--NORTHEAST NEW JERSEY WATERS,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
K. Robinson.
Water Resources Report 39-C: 1.C, June 1983. 151 p, 65 Fig, 17 Tab.

Descriptors: *Rivers, *Watersheds, *Groundwater basins, River mechanics, *Water pollution sources, Ammonia, Coliforms, *Urban watersheds, On-site data collections, Regional analysis, On-site data collections, Regional analysis, Wastewater treatment, Catchment areas, *New Jersey, *Northeast New Jersey water, Water quality.

A water quality inventory of Northeast New Jersey waters included the Elizabeth, Rahway, Passaic and Hackensack river basins and Interstate Sanitation Commisssion waters. The Elizabeth and Rahway River basins have several land use types an have water quality problems which seem to be mostly the result of nonpoint sources originating from intensively developed urban and suburban watersheds. Both rivers show signs of excessive nutrients, and high concentration of ammonia are being found without any apparent source. Samples frequently exceeded a fecal coliform concentration

of 200 MPN/100 ml. The upper Passaic River basin receives over 19.1 mgd of effluent from approximately 40 point source dischargers. Total dissolved solids concentrations also increased in the downstream direction and periodically exceeded 500 mg/l. The Mid-Passaic river area is approximately 67 percent underdeveloped consisting mostly of marsh lands. Samples exceeded the fecal coliform standard although the segment meets the fishable goal. The five mid-Passaic tributaries had generally good water quality in terms of dissolved oxygen, but fecal coliform concentrations were frequently above 200 MPN/100 ml. Point source dischargers need to be upgraded to level 4. In the lower Passaic River basin, water quality was generally poor; the Hackensack River water quality was generally good. It was found that municipal treatment plants for Interstate Sanitation District waters do not provide adequate pollutant removal. (Hawkins-Omniplan)
W85-06353

PRELIMINARY STUDY OF THE WATER QUALITY IMPACT DUE TO THE WANAQUE SOUTH PROJECT.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
May 1982. 77 p. 25 Tab, 19 Ref. Prepared for New Jersey District Water Supply Commission and Hackensack Water Company.

Descriptors: *Trophic level, *Mesotrophy, *Dynamic programming, *Reservoirs, *Water quality, *On-site data collection, Flow measurement, Phosphorus, Diversion, Algae, Rivers, Seasonal variation, Flow duration.

A two-phase study of the Wanaque Reservoir consisted of an analysis of the current trophic state of the reservoir and the proposed design of a reservoir water quality model. The analysis revealed that the reservoir was currently in a mesotrophic state, in generally good condition. However, its trophic state is such that any major new input, such as the Wanaque South diversions, of phosphorus to the reservoir will cause it to enter the eutrophic state. Current patterns indicate there is a slight to moderate increase in algae problems; in the winter, water problems remain and possibly might worsen. Peak monthly phosphorus loading is at least twice the annual average loading and roughly equal to the drought loading. During a normal year, the peak diversion pumping and, therefore, the peak phosphorus loading will occur in November. The proposed water quality model should minimize the total phosphorus loading inputs in order to meet the water supply and minimize the water quality impact in the reservoir and its diversion river system. The model should also (1) ensure the required water supply levels, (2) maintain an adequate water quality level in the diversion rivers, (3) maintain the established minimum flow levels in the diversion rivers, and (4) minimize overall management costs. Data requirements should include sampling for loading determination, in-reservoir sampling, and river water quality sampling. A steady state model which was previously used must be replaced by a dynamic or time dependent model. (Hawkins-Omniplan)
W85-06363

MARINE POLLUTION UNDER THE LAW OF THE SEA CONVENTION,
Queen Mary Coll., London (England).
For primary bibliographic entry see Field 6E.
W85-06366

HEALTH AND ENVIRONMENTAL ASPECTS OF SETTING CLEANUP CRITERIA,
Jordan (Edward C.) Co., Inc., Portland, ME.
R. M. Block, J. Dragun, and T. W. Kalinowski.
Chemical Engineering, Vol. 91, No. 24, p 70-73, November 26, 1984. 2 Fig, 10 Ref.

Descriptors: *Groundwater pollution, *Regulations, *Cleanup, Decision making, Planning, Management, Water quality control, Water pollution control.

The development of cleanup criteria is considered. Cleanup criteria, otherwise called action levels, represent the maximum contaminant concentration that may remain in groundwater without causing adverse human health and environmental effects. In many cases an action level will be based on standards or regulations, such as the US EPA drinking water standards. However, if no applicable standards exist, the remedial-action team must negotiate with the appropriate regulatory agency to establish a site-specific action level. Specifics considered include whether or not the substance in question is a carcinogen. For noncarcinogens the acceptable daily intake (ADI) is calculated from total exposure data, including contributions from diet and ambient air. Once an ADI has been calculated, the action level can be determined. In developing the action level one thus considers risk assessments as well as evaluation of available treatment technology, analytical methods, monitoring costs, and economic impacts. (Baker-IVI)
W85-06452

GROUNDWATER CONTAMINATION - PART 3: REMEDIAL ACTION,
R. W. Schneiter, J. Dragun, and T. G. Erler.
Chemical Engineering, Vol. 91, No. 24, p 73-78, November 26, 1984. 1 Fig, 3 Tab, 27 Ref.

Descriptors: *Groundwater pollution, *Water quality control, Water treatment, Decision making, Management, Planning, Water pollution control.

Remedial action seeks to control and/or reduce the effects of contamination on water bearing soil. Several remedial action alternatives are reviewed and the use of risk-benefit analysis in evaluating such options is considered. A remedial action plan consists of one or more treatment and/or management options. Possibilities include no direct cleanup action; in situ treatment; plume containment; or extraction and surface treatment. No action may be an attractive option under conditions of relatively low level contamination dispersed over a larger area where the potential for human exposure is low. In situ treatment, the treatment of contaminated material as it exists in place with minimal soil excavation or extraction can be achieved through physical/chemical treatment or biological treatment. Plume containment can be achieved through extraction well usage, construction of impermeable barriers, or interceptor trenches that interrupt groundwater flow in shallow aquifers. The most extensively applied remedial action is the extraction of the contaminated groundwater, followed by treatment at the surface, using traditional chemical engineering unit processes. (Baker-IVI)
W85-06453

RELATION OF WATER TRANSPARENCY TO SUSPENDED SUBSTANCE CONTENT IN LARGE RIVERS AND WATER BODIES OF THE UKRAINE (O SVYAZI PROZRACHNOSTI VODY S SODERZHANIEM VZVESHENNYKH VESHCHESTV V KRUPNYKH REKAKH I VODOEMAKH UKRAINY),
V. M. Timchenko, and P. V. Sipchenko.
Gidrobiologischeski Zhurnal, Vol. 20, No. 1, p 66-69, 1984. 1 Fig, 8 Ref.

Descriptors: *Transparency, *Turbidity, *Suspended solids, *Rivers, *Lakes, *Ukraine, Organic matter, Water quality control.

An empirical relationship was established between transparency and turbidity and the amount of organic matter suspended in large rivers and other water bodies in the Ukraine. Observations made to gather the data used in establishing these relationships are described. (Author's abstract)
W85-06462

EFFECT OF MECHANICAL AERATION OF INTRA-WATER-BODY PROCESSES IN A STRATIFIED LAKE (VLIYANIE ISKUSSTVENNOI AERATSII NA VNUTRIVODOEMNYE PROTSESSY V STRATIFITSIROVANNOM OZERE),
V. F. Brekhovskikh, and I. A. Korneev.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 69-76, 1984. 4 Fig, 28 Ref.

Descriptors: *Aeration, *Eutrophic lakes, *Stratification, Lake restoration, Phytoplankton, Biomass.

Aeration of a small eutrophic lake is shown to promote removal of biogenic substances to the photic layer. However, due to a high trophic status of the water body such an addition does not cause an increase in the phytoplankton biomass growth rate as compared with that in the control water body. (Author's abstract)
W85-06471

DECHLORINATION AND TRIHALOMETHANE YIELDS,
Maryland Univ., College Park. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W85-06527

IRON AND STEEL INDUSTRY CONSENT DECREE; IMPLEMENTING THE BUBBLE POLICY UNDER THE CLEAN WATER ACT,
T. J. Krueger.
Virginia Journal of Natural Resources Law, Vol. 4, No. 1, p 155-183, Fall, 1984. 234 Ref.

Descriptors: *Bubble concept, *Industrial wastes, *Steel industry, *Iron industry, *Regulations, Legal aspects, Standards, Legislation, Water pollution control, Outfalls.

The bubble concept is a regulatory alternative to limiting pollutant discharge at each discrete outfall. This alternative places a theoretical bubble over an entire plant and regulates the total discharge from that bubble. The individual outfalls within the bubble need not meet specific regulatory limits, but the total emissions from the bubble may not exceed the aggregate of the limits on the individual outfalls. Thus a plant manager may substitute relatively inexpensive discharge reductions at one pipe for more expensive reductions which would otherwise be required at another pipe. This is referred to as a bubble trade. These regulations for the iron and steel industry are an important step toward cooperation among the parties primarily concerned with environmental regulations - industry, environmentalists, and the EPA. Although such private regulatory agreements raise fears about accountability and about the parties' ability to accurately project the results of their agreements, systemic safeguards may protect the economic and environmental concerns of the parties and the public. This regulation by consensus is potentially valuable as it provides certainty, allows quick implementation, and avoids divisive litigation. If the bubble agreement works well in the iron and steel industry, the bubble concept may be applied to other industries and regulatory programs as well. (Baker-IVI)
W85-06530

POLLUTION CONTROL BY EFFLUENT CHARGES: IT WORKS IN THE FEDERAL REPUBLIC OF GERMANY, WHY NOT IN THE U.S.,
Washington Univ., Seattle. Dept. of Economics.
G. M. Brown, Jr, and R. W. Johnson.
Natural Resources Journal, Vol. 24, No. 4, p 929-966, October, 1984. 129 Ref.

Descriptors: *Germany (Federal Republic), *Water pollution control, *Effluent charges, Legal aspects, Economic aspects, Legislation, Political aspects.

The recent Federal Republic of Germany effluent charge law and the political and legal background that permitted this law to be enacted are described. The impact of that law is assessed, although the assessment is necessarily tentative in view of the short experience with the law to date. The economic and legal implications of enacting an effluent charge law in the United States also are analyzed. Included in this discussion are the advantages and disadvantages of state vs. federal enactment, the constitutional objections that might be raised to such a law, and how it might be coordinated with existing water pollution control laws in the United States. (Baker-IVI)
W85-06534

ACID RAIN CONTROL AND UNITED STATES ENERGY POLICY,
Argonne National Lab., IL. Energy and Environmental Systems Div.
D. G. Streets.
Energy, Vol. 9, No. 11-12, p 1049-1063, November/December, 1984. 7 Fig, 4 Tab, 20 Ref.

Descriptors: *Acid rain, *Water pollution control, *Energy, *Public policy, Legislation, Costs, Economic aspects, Sulfur dioxide, Coal, Transportation, Utilities.

The US Congress is currently considering whether to legislate a control program to reduce the perceived effects of acid rain. The effects of such a program would be costly, wide ranging and would have important implications for the development of US energy policy over the next several decades. The proposals call for reductions of between 30 and 50% in emissions of sulfur dioxide in the eastern US. Costs of achieving these reductions are estimated to be in the range of $4-12 billion annually over the next 20 yr so. In addition to the obvious economic impacts, there will be major energy implications, arising from shifts in the patterns of US coal production and consumption; coal resource, transportation and employment effects; electricity price increases; changes in electric utility system mix; effects on manufacturing industries; and penetration of innovative energy technology. The anticipated effects of acid rain control programs in these areas are discussed, together with creative new ways to address the acid rain issue, including targeted control strategies, emissions bubbling and early retirement. Any control program that seeks to reduce emissions enough to relieve the acid rain problems significantly is bound to be costly. The coal and utility industry will have to reevaluate its thinking on system planning and technology choice. (Baker-IVI)
W85-06555

REGIONAL PRIORITIES FOR ABANDONED MINE RECLAMATION IN THE BLACKLICK CREEK WATERSHED, PENNSYLVANIA,
Georgia Univ., Athens. School of Environmental Design.
B. K. Ferguson.
Journal of Environmental Management, Vol. 19, No. 3, p 249-259, October, 1984. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Land reclamation, *Water pollution control, *Strip mines, *Blacklick Creek Watershed, *Pennsylvania, Mine reclamation, Acid mine drainage, Mine wastes, Priorities, Planning, Environmental effects.

The Blacklick Creek Watershed in the Appalachian Plateau of Pennsylvania has been one of the most devastated of old mining regions. There are 300 surface coal mines; 200 sq mi of acid-bearing deep mines are continuously flushed out by groundwater, and 180 acid refuse banks lie exposed to rainfall. A novel framework was developed for setting the priorities for abandoned mine reclamation in the Blacklick Creek Watershed. Planning for abandoned mine reclamation is fundamentally different from other types of regional planning, in that it directs reclamation to places where degradation is worst and conflicts greatest, rather than laying out land uses in harmony with favorable land suitability. The framework that was developed sought to establish reclamation priorities by comparing the 'supply' of sites to be reclaimed (the degrees of old mines' land and water degradation) with the 'demand' for reclamation to be done (the human values represented by the region's demography, land use and other non-mining characteristics). At Blacklick, the degree of disturbance to land depended on how much regrading and revegetation were lacking. The degree of disturbance to water depended on how much pollution an old mine was discharging into the stream system. In regions with other types of mining impacts, disturbance may also depend on such factors as mine fires, subsidence, landslides and water supply damage. The locations, priorities, and phasing of land and water reclamation objectives shown on the resulting maps could guide any reclamation effort, no matter what reclamation technology is applied to achieve the objectives. A reclamation effort carried out in concert with the regional framework would be constantly directed toward types of reclamation projects, with strong leverage for creating the greatest and most rapid benefit for the application of limited reclamation funds. (Moore-IVI)
W85-06607

ETHYLENE DICHLORIDE/ETHYLENE GLYCOL SPILL IN A MAJOR WATER RESOURCE IN BRITISH COLUMBIA,
Public Health Dept. Kamloops (British Columbia).
K. L. Christian, and W. P. Moorehead.
Journal of Environmental Health, Vol. 47, No. 4, p 192-196, January/February, 1985. 4 Tab, 15 Ref.

Descriptors: *Chemical spills, *Water pollution, *Ethylene glycol, *Ethylene dichloride, *British Columbia, Toxicity, Water management, Decision making, Water pollution control, Spills, Public health, Organic compounds.

In March, 1982, a Canadian National Railway train containing hazardous chemicals derailed near Blue River in the interior of British Columbia, Canada. Significant quantities of ethylene dichloride and ethylene glycol were released into the North Thompson River. The local Public Health authority's role in response to this spill is discussed as it relates to the potential threat to domestic water supplies. Of immediate concern in the management of the situation were the extent of the spill, characteristics of the chemicals, interaction of the chemical spill with the environment, identification and notification of water users, characteristics and condition of the river in relation to dissemination of chemical, time factors in relation to the decision-making process and availability of accurate information, and the development of liaison and a climate of trust with the organizations involved. Concern regarding the ethylene glycol was short lived as it is completely soluble in water, the North Thompson River provided a high dilution factor relative to the volume spilled, initial calculations indicated that concentrations would be so low as to tax analytical capabilities of available testing equipment, and the toxicity of ethylene glycol was not significant compared to the ethylene dichloride which was spilled as well. Volatilization is the major transport process for removal of ethylene dichloride from aquatic systems. The US EPA has proposed human health criteria for chlorinated ethanes. The criterion for ethylene dichloride is 7 micro-g/liter. The interaction of the chemical spill and the environment in samples showed the North Thompson River reached the 7 micro-g/liter criterion within 8 weeks. A thorough review of the accident, the chemicals, and available laboratory results led to the decision to remove other water systems at risk from the river for 48 hours. This decision was followed by releases of information to individuals regarding the condition of their drinking water and suggested steps to prevent toxicity. (Baker-IVI)
W85-06610

ARTIFICIAL AERATION OF RIVERS IN LITHUANIA,
Kaunasskii Politekhnicheskii Inst. (USSR).
A. L. Skirkevicius.
Effluent and Water Treatment Journal, Vol. 25, No. 1, p 22-23 and 25, January, 1985. 1 Fig.

Descriptors: *Aeration, *River Nevezis, *Lithuania, Water quality control, Anaerobic conditions, Aerobic conditions, Rehabilitation.

Data collected from the artificial aeration of rivers in Lithuania are presented. Studies were carried out in the River Nevezis which is polluted by inadequately purified wastewater from the town of Panevezys. An experimental station, Nevezis I, was equipped with mechanical aerators with a capacity of 2.2 kw. The width of the river is 16-20 m and the length of the structure is 12 m. While artificial aeration under aerobic conditions did not lead to a significant increase in the powers of self-purification, it did prevent a reduction in self-purification, as it does stop the formation of anaerobic areas. Therefore, one must be careful not to overestimate the advantages of artificial aeration. It can be an inexpensive means of effective help to some degree to rivers. (Baker-IVI)
W85-06629

ESTIMATING THE EFFECTIVENESS OF VEGETATED FLOODPLAINS/WETLANDS AS NITRATE-NITRITE AND ORTHOPHOSPHORUS FILTERS,
Agricultural Research Service, Fort Pierce, FL. Southeast Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W85-06634

ROLE OF HIGHER AQUATIC VEGETATION IN IMPROVING WATER QUALITY AND INCREASING BIOLOGICAL PRODUCTIVITY OF RESERVOIRS,
A. B. Avakyan, and L. O. Einor.
Hydrotechnical Construction, Vol. 18, No.9, p 454-459, September, 1984. 12 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 57-61, September, 1984.

Descriptors: *Aquatic plants, *Reservoirs, *Water quality control, *Productivity, Macrophytes, Plants, Water quality, Drinking water, Design criteria.

Self-purification of natural water on the basis of the vital activity of the biota occurs as a result of the activity of all groups of aquatic organisms, since for them water is not simply a habitat but also a product of vital activity. Macrophytes in the case of their controlled development are an effective means of improving water quality. The participation of hydrobiologists and geobotanists both in the design and construction of reservoirs will help to establish the effectiveness of self-purification being accomplished by components of the biota and especially by macrophytes. When designing reservoirs and their engineering it is necessary to take into account natural conservation measures aimed at improving water quality, including a bank water-protection zone, beaches, bioplateaus with macrophytes, means for harvesting the plant biomass, and condition of its transporting, processing, and utilization in the economy. (Baker-IVI)
W85-06713

WATER QUALITY FROM EROSION CONTROL STRUCTURES IN NEBRASKA,
Nebraska Univ.-Lincoln.
For primary bibliographic entry see Field 2J.
W85-06716

PESTICIDE AVAILABILITY INFLUENCE OF SEDIMENT IN A SIMULATED AQUATIC ENVIROMENT,
Agricultural Research Service, Beltsville, MD. Pesticide Degradation Lab.
For primary bibliographic entry see Field 5B.
W85-06783

CONTAMINATION OF AQUIFERS BY OVERPRESSURING THE ANNULUS OF OIL AND GAS WELLS,
Allegheny Coll., Meadville, PA.
For primary bibliographic entry see Field 5B.
W85-06820

CONTROL OF GROUND WATER CONTAMINATION AT AN ACTIVE URANIUM MILL,
Earth-Fax Engineering, Inc., Murray, UT.
R. B. White, and R. B. Gainer.
Ground Water Monitoring Review, Vol. 5, No. 2, p 75-82, 1985. 12 Fig, 1 Tab, 26 Ref.

Descriptors: *Groundwater contamination, *Uranium mills, *Seepage, *Utah, *Water pollution control, *Mine wastes, *Dakota-Burro Canyon Formation, Path of pollutants, Geohydrology, Aquifers, Groundwater movement, Geologic fractures.

Seepage from tailings ponds associated with an active uranium mill in Utah has resulted in con-

tamination of groundwater contained in the Dakota-Burro Canyon Formation. This aquifer is used in the area as a supply for domestic and industrial wells. Results of very low-frequency electromagnetic surveys and groundwater quality investigations at the site indicated that the flow of groundwater and contaminants is primarily fracture-controlled. Pumping tests were conducted to determine the hydraulic characteristics of the fractured system. The extent of contaminant migration was then determined using an analytical model of transport in fractured aquifers. Based on these investigations, a plan was designed to control future, and cleanup past, groundwater contamination. This plan consists of pumping from a single well intersecting the main fracture that transports contaminants off the site. The effectiveness of the plan was analytically modeled, taking account of the anisotrophy of the groundwater system. Subsequent monitoring of water levels in the area indicates that the plan has been effective since its inception in November 1983. (Author's abstract)
W85-06833

LYSIMETERS ALLOW QUICKER MONITORING OF HEAP LEACHING AND TAILING SITES,
Environmental Services International, Denver, CO.
W. R. Bond, and J. V. Rouse.
Mining Engineering, Vol. 37, No. 4, p 314-319, April, 1985. 2 Fig, 4 Ref.

Descriptors: *Lysimeters, *Mine wastes, *Leaching, *Monitoring, Leachates, Spoil banks, Water pollution control, Construction.

Pressure/vacuum (p/v) lysimeter use at mine sites has proven to be a valuable early warning system for detecting leakage of leachate fluids. Such a device can detect solution leaks in several days or weeks, whereas a conventional perimeter monitor well may take months or years. The basic design of a p/v lysimeter chamber consists of a porous material through which the soil water is drawn into a collection chamber. Access tubes run from the unit to the sample station at the ground surface. Most units currently available range from 25 to 76 mm diameter (1-3 inches). The intake, of porous material, on the lysimeter is the most complex and vulnerable portion of the unit. Installation techniques for permanent placement of p/v lysimeters are varied. High pressure units can be installed at depths up to 91 m below grade or serviced by sample tubes up to 152 m (500 ft) in linear distance. Factors to be considered in choosing an installation procedure include the geology of the area, chemical nature of the leachate fluid, site access, and the head differential from the lysimeter unit to the sample station and the friction involved with forcing the water sample through a small tube over a long distance. Where atmospheric oxygen may alter the water sample parameters being analyzed, a nitrogen gas tank should be used as a pressure source. In this way, the atmospheric oxygen contact with the sample is limited and the lysimeter unit is purged with the nitrogen gas. Timing of lysimeter installations into the contractor's overall schedule is very important. The most critical aspect in the case in point was the completion of all rough grade work for the pond base. The drill rig was then mobilized and installation began without concern for disturbing the finished grade. (Baker-IVI)
W85-06838

MODELING FLUID FLOW IN SELECTIVE PLACEMENT OF TOXIC MINE SPOIL,
Pennsylvania State Univ., University Park. Dept. of Mining Engineering.
For primary bibliographic entry see Field 5B.
W85-06839

ORGANOTIN COMPOUNDS AND INTERNATIONAL TREATIES ON THE POLLUTION OF WATER BY DANGEROUS SUBSTANCES: BLACK OR GREY LIST SUBSTANCES,
H. Vrijhof.
Science of the Total Environment, Vol. 43, No. 3, p 221-231, 1985. 4 Tab, 7 Ref.

Descriptors: *Organotin compounds, *Tin, *International agreements, *Black lists, *Grey lists, *Water pollution control, Environmental protection, Treaties, International law, Metals, Trace metals.

Shortly after the Oslo, London, and Stockholm pollution treaties, international treaties on the pollution of water by dangerous substances, based on the black and grey list classification, were being prepared in Paris, Helsinki, Barcelona and Strasbourg, under the auspices of the International Rhine Commission and the European Economic Community. In each of these treaties, organotin compounds, which had not been mentioned in the Oslo and London Conventions, appear on the black or the grey list. According to the text of the 1974 Paris Convention, organic compounds of tin are included on the grey list because, although exhibiting similar characteristics to the substances in the black list and requiring strict control, they seem less noxious or are more readily rendered harmless by natural processes. It may be assumed that lack of familiarity with the characteristics of organotin compounds also played a role. Contracting parties to the 1974 Helsinki Convention agreeed to take all appropriate measures to monitor and strictly limit land-based pollution of inland seas by noxious substances and materials contained in a grey list which includes tin and its organic and inorganic compounds but which does not give tin highest priority. Organotin compounds are omitted from both the black and grey list of the 1976 Barcelona Convention which regulates dumping from ships and aircraft but are included in the black list of the 1980 Athens protocol to the Barcelona Convention which regulates the problem of land-based pollution. The Rhine Chemical Convention and the Dangerous Substances Directive 76/464/EEC and the Groundwater Directive 80/68/EEC placed organotin compounds on black lists as well. No scientific arguments have apparently been put forward to date either in support of these priorities or to explain the need to move this group of substances to the black list. The lack of a general understanding of the chemistry, the origin and the biological effect of organotin compounds in the aquatic environment makes it appear that the selection has been based mainly on production figures. (Author's abstract)
W85-06845

NUTRIENT LOAD, TROPHIC CONDITION AND RESTORATION PROSPECTS OF LAKE MAGGIORE,
Istituto Italiano di Idrobiologia, Novara.
For primary bibliographic entry see Field 2H.
W85-06883

DRINKING WATER SUPPLIES, PROTECTION THROUGH WATERSHED MANAGEMENT,
North Carolina Univ. at Chapel Hill. Center for Urban and Regional Studies.
R. J. Burdy, E. J. Kaiser, J. L. Miller, and D. H. Moreau.
Ann Arbor Science, Ann Arbor, MI. 1983. 272 p.

Descriptors: *Water quality control, *Water pollution prevention, *Watershed management, *Water supply, *Drinking water, Water pollution sources, Water pollution effects, Public health, Legal aspects, Water law, Urbanization, Water management, Land use, Agricultural watersheds, Planning, Water treatment, Wastewater treatment, Nonpoint pollution sources, Erosion control, Storm water, Septic tanks, Taxes, Monitoring, Protection, Industrial waste, Model studies, Zoning, Permits, Waste disposal, Property rights.

This guidebook is designed as a resource document for formulating watershed management programs to protect water supply sources. Background material includes the major problems addressed by watershed management, the historical evolution of source protection, types of pollution in surface waters, sources of pollution, impacts of pollution on receiving waters, health effects of pollution, and the state of watershed management practices in the U.S. A 12-step procedure for identifying problems using existing management policies is proposed. In addition, methods for evaluating the relative importance of these problems is given. Various aspects of formulating a watershed management program include the direction-setting dimensions (goals, target pollutants, sources, locations, land use, etc.), intervention measures (regulatory measures, property rights acquisition, capital impovements, and preferential taxation), and formulation of the final management program. Monitoring and evaluation methods are described so that the necessary mid-course corrections are possible.
W85-06934

POLLUTION CONTROL FACILITIES PROJECT SOUTHEASTERN OAKLAND COUNTY SEWAGE DISPOSAL SYSTEM, OAKLAND COUNTY, MICHIGAN: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Technical Report HL-82-4, February 1982. Final Report. 32 p, 18 Fig, 2 Tab.

Descriptors: *Water pollution control, *Weirs, *Models studies, *Hydraulic models, *Wastewater treatment, *Sewer systems, *Head loss, *Mathematical studies, Water pollution prevention, Water pollution treatment, Settling basins, Models, Mathematical models.

Head losses through the Red Run Drain Pollution Control Structure were determined for a range of discharges and tailwaters. Two 1:20-scale models were used to determine head losses through two vee-shaped weir and baffle structures, and calculations, using Manning's equation, were used to determine losses in the retention basin. Results showed that the roughness of the retention basin is highly significant in determining head losses. Curves were generated to calculate head losses for a given discharge and tailwater. Modifications to the pollution control structure were tested. These included streamlining an abrupt ceiling transition and eliminating roughness caused by ceiling beams. These modifications had little effect on the total head loss through the structure. Opening the downstream access gate also had a negligible effect on total head losses. The model provided sufficient data to study the effect of the pollution control structure on flooding in the upstream drainage basin.
W85-06937

GUIDE TO GROUND-WATER STANDARDS OF THE UNITED STATES.
Ecological Analysts, Inc., Sparks, MD.
For primary bibliographic entry see Field 6E.
W85-06940

OPTIMIZING SALINITY CONTROL STRATEGIES FOR THE UPPER COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5C.
W85-06960

OIL SPILL BARRIERS AND THEIR USE,
Environmental Protection Service, Ottawa (Ontario).
L. A. Robertson.
EPS 3-EC-81-5, December 1981. 95 p, 31 Fig, 4 Tab, 7 Ref, 1 Append.

Descriptors: *Oil spills, *Barriers, *Water quality control, *Shore protection, *Environmental protection, Cleanup operations, Canada, Beaches, Water pollution prevention, Flotation, Bubbles, Jets, Absorption, Dams, Ice, Water currents, Marinas, Harbors, Waves, Buoys, Wind, Temperature, Tides, Water depth, Tidewater, Air curtain.

Barriers (mechanical, air curtain, and water jet) to control the spread of oil and other floating contaminants are described. The basic components of mechanical barriers are flotation, skirt, ballast, and tension members. Some have additional features such as vertical stiffeners, anchor points, hand-

holds, and connectors. Barriers commercially available in Canada include skirt (curtain) type, fence type, miscellaneous (inflated tubes and sorbent barriers), pneumatic barriers (air or bubble curtain), and water jets. These commercial barriers are described in detail in the Appendix. Some barriers which have been improvised for use in emergencies or remote areas are chicken wire sausage and chicken wire jelly roll filled with straw, snowfence with sorbent, chicken wire and floating drums with sorbent, plywood and barrels, plywood inserted vertically through ice, styrofoam logs in burlap, small dams of earth or sand bags, log booms, and boards. Environmental factors to consider before deploying barriers include current, wind, waves, temperature, tides, and water depth. Deployment methods and equipment, including techniques for current and non-current situations, are detailed. Controlled drift and towing in catenary techniques are effective for tidal and deep offshore areas.
W85-06972

WATER QUALITY OPTIMIZATION THROUGH SELECTIVE WITHDRAWAL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
A. B. Poore, and B. Loftis.
Technical Report E-83-9, March 1983. Final Report. 41 p, 1 Fig, 15 Ref, 1 Append.

Descriptors: *Water quality control, *Optimization, *Reservoir operation, *Lakes, Algorithms, Mathematical studies, Stratification, Reservoir releases, Outlets, Multipurpose reservoirs, Multiobjective planning.

This report discussed the problem of operating a multipurpose reservoir through regulation of a multilevel outlet works for a number of water quality objectives. Operation of a reservoir to meet downstream goals for multiple water quality parameters often results in conflict. A problem formulation and solution are presented as an attempt to resolve these conflicts. The multi-parameter reservoir regulation problem is fomulated in terms of a scalar objective function, which indicates the relative value of any specified operation strategy, and a linear constraint set. These constraints include the hydraulic characteristics of the outlet works and any specified bounds on the release concentrations of the water quality parameters. Two different problem formulations are addressed. The target-concentration problem is formulated to achieve specific downstream target. Concentrations without actual constraints on the release concentrations. The constrained-concentation problem is formulated to allow the specification of upper and lower bounds for all or some of the water quality constituents. Both formulations can accurately deal with the hydraulic complexity of a multilevel outlet works. The algorithms presented herein can be used to regulate a reservoir in a real-time mode in which the state of the system is known by actual measurements. The algorithms can also be used with an ecosystem simulation model in which the state of the system is predicted. (Author)
W85-06974

OVERVIEW OF CURRENT SPILL CLEANUP TECHNOLOGY,
Municipal Environmental Research Lab., Cincinnati, OH.
R. A. Griffiths.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116939. EPA-600/D-82-341, 1982. 14 p, 2 Tab, 30 Ref.

Descriptors: *Cleanup operations, *Chemical spills, *Dispersants, *Surfactants, *Biodegradation, Skimming, Booms, Turbulent flow.

A review of the equipment and techniques for responding to spills of dangerous cargoes is presented. Categorizing spilled products as floaters, sinkers, mixers, or vapors provides a convenient viewpoint for discussing response technology, which depends strongly on which behavior the product exhibits. Spills of radioactive and bateriological agents are not covered in this paper, though the potential use of bacteria for mitigating oil or chemical spills is noted. The technologies for responding to spills of floaters and sinkers are shown to be the most well developed of the four types. Equipment and techniques in common use by the United States and Canadian governments are discussed to illustrate this. Current technology includes both removal of the pollutant using now-conventional equipment such as booms, skimmers, dredges, or sorbents and in-place treatment such as chemically-enhanced dispersion, enhanced microbiological degradation, or in-place burning. Significant weaknesses are noted, however, in three areas: spill cleanup in rough seas, in fast currents, and in the arctic (or cold climates). Little technology is available for response to spills of mixers or vapors, and a major concern at these spills continues to be the safety of the response equipment operators and divers. Experimental, infrequently-used techniques for in-place treatment and for actual cleanup and removal are discussed.
W85-06975

LEACHABILITY AND REVEGETATION OF SOLID WASTE FROM MINING,
Industrial Environmental Research Lab.-Cincinnati, OH.
M. L. Apel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-136010. EPA-600/2-82-093, November 1982. 160 p, 97 Fig, 9 Tab, 35 Ref, 5 Append.

Descriptors: *Mine wastes, *Leachates, *Fate of pollutants, *Waste disposal, *Land reclamation, *Sludge disposal, *Water quality control, *Drainage, Acid mine drainage , Neutralization, Pyrite, Geochemistry, Contrary Creek, Virginia, Disposal, Metals, Vegetation, Lime, Fertilizers, Mine drainage, Solid wastes, Spoil disposal, Wastes.

Several strategies for disposing of pyrite mine solid wastes were evaluated by pilot plant leaching columns at Contrary Creek, Virginia. The best option was covering the waste with 1.2 m of cover soil. The next best technique involved mixing sewage sludge, fertilizer, and lime into the upper layer of waste. Placing a mixture of sludge and fertilizer on top of lime-treated mine waste was less effective than incorporation of the neutralizing materials. However, a lime layer spread between mine waste and cover soil produced column leachates of poorer quality than the control column. Vegetation was quickly reestablished on the soil cover but was much slower and 75% less dense than in soil amended experiments. No vegetation grew on the untreated mine waste. A thin layer of lime between the cover soil and mine waste greatly improved root penetration into the mine waste layer.
W85-06990

PROCEEDINGS OF STORMWATER AND WATER QUALITY MODEL USERS GROUP MEETING: JANUARY 27-28, 1983.
Environmental Protection Agency, Athens, GA. EPA-600/9-83-015, September 1983. University of Florida, Gainesville. Edited by Thomas O. Barnwell. 282 p.

Descriptors: *Computer models, *Model studies, *Mathematical models, *Hydrological models, *Water quality, *Water supply, *Water pollution sources, Simulation analysis, Symposiums, Water managment, Nonpoint pollution sources, Pesticides, Forest management, Storm sewers, Snowmelt, Detention reservoirs, Storm runoff, Areal precipitation.

This report includes 17 papers on topics related to the development and application of computer based mathematical models for water quantity and quality management presented at the semi-annual meeting of the Joint U.S.-Canadian Stormwater and Water Quality Model Users Group held on January 27-28, 1983 in Gainesville, Florida. Topics covered included an application of the QUAL-II model in the Northeastern U.S. and Columbia, South America; applications of STORM in Singapore and the Republic of China; and implementation of SWMM in Tunisia. Modeling pesticides in small ponds and mixing zones in rivers was also discussed, as well as sizing detention ponds to meet water quality objectives. A program to assess the impact of forest management practices on water quality was also presented as was a mechanistic model for nonpoint source simulation. Papers related to precipitation discussed data management, estimation of missing values, and areal intensity-duration-frequency curves. The questions of hydrological regionalization, snowbelt, and porous pavements were addressed. Other papers discussed regional stormwater management facilities and storm sewer design optimization. (Author's abstract)
W85-06999

PROJECT SUCCESS: SENSITIVITY TO PROJECT ASSUMPTIONS, 'THE MEDELLIN CASE',
Dames and Moore, Bethesda, MD.
For primary bibliographic entry see Field 6A.
W85-07000

LOSSES FROM EFFLUENT TAXES AND QUOTAS UNDER UNCERTAINTY,
Geological Survey, Reston, VA.
W. D. Watson, and R. G. Ridker.
Journal of Environmental Economics and Management, Vol. 11, No. 4, p 310-326, December, 1984. 4 Fig, 5 Tab, 8 Ref.

Descriptors: *Cost analysis, *Water pollution control, *Uncertainty, *Taxes, Effluent taxes, Damages, Benefits, Cost-benefit analysis.

Empirical estimates are provided of expected control and damages costs for the so-called criteria air and water pollutants, using functions that reflect current knowledge. This analysis uses nonlinear control cost and damage functions and multiplicative nonsymmetric errors for both the control and damage cost functions. For a set of alternative plausible scenarios, the empirical analysis demonstrates that selective application of effluent charges could reduce expected social losses to the nation by as much as several hundred billion dollars over the period from 1975 to 2025. Reduction in social losses could require time-dependent application of both kinds of policy instruments; for example, quotas in early years followed by effluent charges in later years. A conceptual framework is provided and the methods used to empirically estimate expected control and damage costs under effluent charges and quotas are described. Estimates of expected control and damage costs are provided and the efficient policy instrument, an EPA relaxed policy, and an optimal policy are identified. Sensitivity tests for the cost comparisons are offered by repeating the calculations using different values for key parameters. (Baker-IVI)
W85-07089

POSSIBLE EFFECTS OF FORESTRY ON INLAND WATERS OF TASMANIA; A REVIEW,
Forest Ecology Research Fund, Launceston (Australia).
For primary bibliographic entry see Field 4C.
W85-07145

EFFECTIVENESS OF HYDROTREATMENT IN REDUCING THE TOXICITY OF A COAL LIQUEFACTION PRODUCT TO JUVENILE CHANNEL CATFISH,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. F. Cada, and M. Kenna.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 5, p 746-753, May, 1985. 1 Fig, 1 Tab, 11 Ref. DOE contract DE-AC05-840R21400.

Descriptors: *Hydrotreatment, *Coal liquefaction, *Toxicity, *Wastewater treatment, Fish, Synthetic fuels, Fuels, Catfish.

Because coal-derived oils contain many organic compounds that are readily soluble in water and also toxic to aquatic biota, coal oil spills are expected to be more damaging to the environment than petroleum oil spills. The effectiveness of hydro-

treatment in reducing the acute toxicity of a representative coal liquefaction product was evaluated. Acute bioassays with juvenile channel catfish were used to compare the toxicities of raw H-Coal oil, four samples of the same H-Coal oil subjected to different degrees of upgrading by hydrotreatment, and a petroleum crude oil. Upgrading by means of hydrotreatment can be an effective mitigative measure for reducing at least the short-term environmental hazards of coal liquids. Although a relatively high severity of hydrotreatment was necessary, the acute toxicity of H-Coal oil was reduced to a level comparable to or below that of petroleum crude oil. Because the cost of hydrotreating coal liquids may be offset by the subsequent process engineering advantages it confers, as well as the reduced need for special storage, handling, and transportation facilities, hydrotreatment should prove to be a valuable tool in the environmentally sound development of coal liquefaction technologies. (Baker-IVI)
W85-07152

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

PLANNING FOR DROUGHT: THE ROLE OF STATE GOVERNMENT,
Nebraska Univ.-Lincoln. Inst. of Agriculture and Natural Resources.
D. A. Wilhite, and D. A. Wood.
Water Resources Bulletin, Vol. 21, No. 1, p 31-38, February, 1985. 4 Fig, 10 Ref. NSF grant ATM-8108447.

Descriptors: *Drought, *Planning, *State government, Emergency planning, Water shortage, Drought response plans, Water supply, Water management, Colorado, South Dakota, New York.

Although droughts are a frequent occurrence over much of the United States, response by state and federal government has been ineffective and poorly coordinated. Recently, several states have recognized the value of drought emergency planning and have developed plans to assist them in responding more effectively to prolonged periods of water shortage. These states have created an organizational structure to coordinate the assessment and response activities of state and federal agencies. Each state's drought response plan is unique since each state's water supply and management problems, and their consequent impacts, are unique. The drought response plans developed by Colorado, South Dakota and New York are reviewed here in detail. It is recommend that other states affected by frequent and severe water shortages also develop drought emergency plans. These plans will enhance state government's ability to implement effective measures in a timely manner and, ultimately, may provide added incentive for the federal government to develop the national drought response plan called for by the General Accounting Office in 1979. (Author's abstract)
W85-06236

MATRIX AND ACCOMPANYING CLASSIFICATIONS FOR IDENTIFYING WATER RESEARCH PROBLEMS AND NEEDS,
Ohio Agricultural Research and Development Center, Wooster.
R. L. Vertrees.
Water Resources Bulletin, Vol. 21, No. 1, p 115-133, February, 1985. 4 Fig, 33 Ref, 2 Append.

Descriptors: *Research priorities, *Water resources, Planning, Water resources institutes, Organizations.

A matrix was developed of problems with the functional use of water resources (rows) and functions served by water resources research (columns). A classification of water problems and a classification of research fields also were developed to accompany the matrix. The matrix and classification schemes were used when preparing the five-year research and development plan of the Water Resources Center of The Ohio State University. They were used: (1) to classify each research project that had been supported by the Water Resources Center from 1965 through 1980, (2) to guide interviews with personnel of federal and state agencies and university faculty who assisted in defining Ohio's water research needs, (3) to organize responses received during these interviews, and (4) to arrive at a selected list of ten problems with the functional use of Ohio's water resources that were prioritized based upon opinions received from water-related officials throughout the state. Other matrices and classification schemes are reviewed that were revised and expanded upon when formulating the ones used in Ohio. Suggestions are given regarding further development of the functional matrix and accompanying classifications as well as their use in administration of the cooperative federal-state water resources research program and other federal water resources research programs. (Author's abstract)
W85-06246

PLANNING EFFECTIVE INDUSTRIAL LIQUID WASTE CONTROLS IN DEVELOPING NATIONS,
Democritus Nuclear Research Center, Athens (Greece).
A. P. Economopoulos.
Environmental Monitoring and Assessment, Vol. 4, No. 2, p 119-128, June, 1984. 4 Ref.

Descriptors: *Planning, *Developing countries, *Water pollution control, *Industrial wastes, Wastewater treatment, Wastewater disposal, Monitoring, Land use.

Environmental planning principles are described which address a problem which many developing nations face at some point along the way. This problem is alarming levels of water pollution and limited background, expertise and organization to combat it effectively. The fundamental differences between developing and developed countries hamper the successful straightforward transplantation of methodologies, design practices, legislation and standards from the latter to the former. The main objective of initial environmental planning is to provide a specific and rational solution to the immediate problems of the pollution abatement authorities. The cost important information for the formulation of the pollution abatement strategy is the knowledge of the size and location of the pollution sources as well as the identification of the receivers. A realistic environmental strategy also takes into consideration the existing economic, technical and organizational constraints. Waste control strategy for existing industries is considered. (Baker-IVI)
W85-06287

ECONOMIC, LEGAL AND INSTITUTIONAL RELATIONS INVOLVED IN DIVERSION AND OTHER INTERBASIN TRANSFERS,
Connecticut Univ., Storrs. Inst. of Water Resources.
M. Huffmire, L. Frankel, M. Altobello, and R. Laak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 161412/AS, Price codes: A10 in paper copy, A01 in microfiche. Project Completion Report, (1984). 185 p, 5 Fig, 97 Map, 8 Tab, 79 Ref, 8 Append, Project No. OWRT B-020-CONN (1), Contract/Grant No. 14-34-0001-1281.

Descriptors: *Interbasin transfer, *Water shortage, Diversion, Economic aspects, Geohydrology, Legal aspects, Water transport, *Connecticut, *Economic models.

Using economic theory, a model was constructed to illustrate how a regional water authority could allocate existing water resources to best serve a region. The model was applied to southwestern Connecticut, a region that has recently experienced rapid industrial and population growth and has, from time to time, reported water shortages. Data from 1979 were used as the model base and projections were made for the years 1985 and 2000. The conclusions reached are that with better integration of existing water sources an ample supply of water would be available to about the year 2000. After this time the region would experience a water deficit. However, the large costly river diversion schemes proposed by others are not deemed necessary. The geological and environmental part of this study indicates that stratified drift deposits closer than the proposed river diversions projects would supply the needed water, but that the land over and close to these deposits would require more stringent control to prevent further groundwater contamination. The legal problems involved in the water transfers and diversions are discussed. It is recommended that a severence tax be imposed on all water imported into a community from outside its boundaries. This would compensate the supplying area for the loss of a resource and probably foster conservation and better water management in the receiving area.
W85-06304

PROBLEM ORIENTED EVALUATION OF INSTITUTIONAL DECISION MAKING AND IMPROVEMENT OF MODELS USED IN REGIONAL URBAN RUNOFF MANAGEMENT: APPLICATION TO INDIANA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. W. Delleur, J. M. Bell, and M. H. Houck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 161438/AS, Price codes: A06 in paper copy, A01 in microfiche. Project Completion Report, Technical Report No. 164, May 1984. 102 p, 29 Fig, 30 Tab, 1 Ref, Project No. OWRT C-00090-U (5), Contract/Grant No. 14-34-0001-0498.

Descriptors: *Urban runoff, Stochastic models, Watershed management, Urban hydrology, Rainfall-runoff relationships, *Indiana.

The principal objective of the research is to evaluate, in a multidisciplinary framework, problems of regional runoff management, with special attention to Indiana. One focus of the research is on institutional issues affecting management. It was found that although 208 planning was never a smooth process in the two study regions, it may in fact have laid foundation for future water quality management programs within the regions. The other focus of the research is on models that may be used to improve runoff management. To support this work, a small watershed in West Lafayette, Indiana, was monitored with an automated data collection, data processing, and data storage system. An investigation of the effects of hydrologic conditions on the quality of urban runoff from this water-shed concluded that: the watershed generally exhibits a first flush in concentration for all pollutants monitored; and there is no apparent relationship between the quantity of previous rainfall or the length of the antecedent dry period or the time elapsed since street sweeping and the quality of stormwater runoff. The selection of parameter estimates for rainfall-runoff models is quite important. Two techniques to obtain 'optimal' estimates are compared. The results from this analysis confirm that the objective function that makes use of the maximum likelihood estimator gives improved parameter estimates. Another investigation has demonstrated the need for a general planning methodology for use in the design of dual purpose detention basins. Such a methodology is developed, tested, and appears to work very well. The general interaction of both storage and pipe costs and flowrate and pollutant constraints in relation to the overall system design is illustrated. Any general conclusions should be delayed.
W85-06306

ECONOMIC, LEGAL AND INSTITUTIONAL RELATIONS INVOLVED IN DIVERSION AND OTHER INTERBASIN TRANSFERS,
Connecticut Univ., Storrs. Inst. of Water Resources.
M. Huffmire, L. Frankel, M. Altobello, and R. Laak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 161446/AS, Price codes: A09 in paper copy, A01 in microfiche. Project Completion Report, (1984). 185 p, 5

Fig, 97 Maps, 8 Tab, 79 Ref, 8 Append, Project No. OWRT B-020-CONN (1), Contract/Grant No. 14-34-0001-1281.

Descriptors: *Interbasin transfers, *Water shortage, Diversion, Economic aspects, Geohydrology, Legal aspects, Water transport, *Connecticut, *Economic models.

Using economic theory, a model was constructed to illustrate how a regional water authority could allocate existing water resources to best serve a region. The model was applied to southwestern Connecticut, a region that has recently experienced rapid industrial and population growth and has, from time to time, reported water shortages. Data from 1979 were used as the model base and projections were made for the years 1985 and 2000. The conclusions reached are that with better integration of existing water sources an ample supply of water would be available to about the year 2000. After this time the region would experience a water deficit. However, the large costly river diversion schemes proposed by others are not deemed necessary. The geological and environmental part of this study indicates that stratified drift deposits closer than the proposed river diversion projects would supply the needed water, but that the land over and close to these deposits would require more stringent control to prevent further groundwater contamination. The legal problems involved in the water transfers and diversions are discussed. It is recommended that a severence tax be imposed on all water imported into a community from outside its boundaries. This would compensate the supplying area for the loss of a resource and probably foster conservation and better water management in the receiving area. W85-06307

DELAWARE RIVER BASIN COMPREHENSIVE (LEVEL B) STUDY.
Delaware River Basin Commission, West Trenton, NJ.
Fianl Report, May 1981., 88 p. 15 Fig, 27 Tab, 169 Ref, 1 Append.

Descriptors: *Delaware River Basin, *Regional planning, *Hydraulic gradient, *Fluid mechanics, *Dam design, *Environmental effects, *Wet climates, *Precipitation intensity, *Water users, Weather patterns, Water reuse, Recirculated water, Planning, Tocks Island Reservoir.

In the 1960s, a comprehensive plan for the immediate and the long-range development of the Delaware River Basin was developed that had as its cornerstone the Tocks Island Reservoir Project. When construction on that project was delayed indefinitely, this study was begun to revise the comprehensive plan. There is adequate water in the basin to meet needs during years of normal precipitation. Most water used within the basin is returned after treatment and becomes available for reuse. About 50 percent of the Potamac-Raritan-Magothy (P-R-M) system recharge comes from the tidal Delaware River during normal water years and 1980 levels of pumping. The percentage of river recharge could be as high as 70 percent during a drought period in the year 2000. Large withdrawls from P-R-M have caused a series of deep cones of depression which have reversed the hydraulic gradient from discharge to the estuary to recharge from the estuary. This exposes the P-R-M aquifer system to degradation from spills of toxic or hazardous materials, and intrusion of sea salts from the estuary. Water quality in most of the basin streams has improved over the last several years, although some show low DO concentrations. Increasing the flow of the Delaware River at Trenton, NJ, from 2,000 cfs to 3,475 cfs would increase the DO in Zone 2 by as much as 1 mg/l. The 1980 population of the basin was 7,240,000, and is projected to increase to 8,057,000 by the year 2000. A supplemental flow capability of about 2,800 cfs will be needed to overcome present deficiencies and meet year 2000 demands. (Hawkins-Omniplan)
W85-06336

IRRIGATED AGRICULTURAL DECISION STRATEGIES FOR VARIABLE WEATHER CONDITIONS,
New Mexico Water Resources Research Inst., Las Cruces.
R. R. Lansford, T. S. Sammis, J. T. McGuckin, R. A. Deinter, and J. A. Libbin.
New Mexico Water Resources Research Institute Report No. 170, December 1983. 51 p. 12 Fig, 8 Tab, 24 Ref, 2 Append.

Descriptors: *New Mexico, *Rainfall intensity, *Rainfall area, *Rainfall impact, *Agricultural hydrology, *Precipitation, *Model studies, *Depth-area-duration analysis, *Simulation analysis, Simulated rainfall, Evapotranspiration, Weather, Crop yield, On-site data collections, Water demand, Risks.

Steadily increasing production costs coupled with low crop prices have place many farmers in a severe economic bind. For producers irrigating from deep wells, the sharply higher energy costs for pumping have increased the uncertainty for the future. Research was conducted to develop an irrigated agricultural decision-making model that included a probabilistic precipitation prediction model, water-production functions, and an economic decision strategy dynamic programming model (DPM). The weather simulation model, which was a good estimator of yearly rainfall, tended to overestimate solar radiation but was satisfactory for other climate parameters. The irrigation scheduling model was generally consistent with the measured seasonal evapotranspiration for corn but overpredicted seasonal evapotranspiration for wheat. Comparison of the DPM with physically based irrigation models indicated that the DPM increased net returns per acre from $7 to $25 for corn with flood irrigation and $2 to $106 per acre for sprinkler systems. For wheat, the DPM increased net returns from $1 to $15 for flood irrigation and $20 to $38 for sprinkler systems. The DPM also estimated water demand functions for corn, sorghum, and wheat. The demand for water was inelastic for corn but elastic for wheat and sorghum. The DPM can be used by farmers with an on-farm microcomputer. (Hawkins-Omniplan)
W85-06340

RECOMMENDED PROCEDURES FOR EVALUATING TRADE-OFFS BETWEEN CBOD AND NBOD IN THE WASTELOAD ALLOCATIONS, (DRAFT),
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
H. Hundal, T. Jenq, and H. Litwack.
June 1983. 8 p.

Descriptors: *Chemical oxygen demand, *Oxygen depletion, *Water quality, *Wastewater facilities, *Oxygen demand, *Dissolved oxygen, *Anaerobic conditions, *Numerical analysis, Parametric hydrology, Treatment plants, Mathematical studies, Permits, Hydraulic transportation.

A principal water quality impact of discharges from treatment plants into receiving waters is the depletion of dissolved oxygen (DO) due to stabilization of carbonaceous oxygen demand (CBOD) and nitrogenous oxygen demand (NBOD). If trade-offs between CBOD and NBOD can be made without shifting the DO deficit, there could be substantial savings in what would need to be spent to modify plants to meet new permit limitations. This study develops a theoretical background and a technical procedure for processing applications for adjustment of CBOD and NBOD in the plant effluents. The extent of DO depletion due to the stabilization of CBOD and NBOD, is determined by the respective decay rates, reaeration and the hydraulic transport mechanisms specific to the water body in question. Three cases may be considered for making a trade-off in the wasteload allocations: (1) simple first order decay without reaeration and hydraulic effects; (2) stream sections (advection with plug-flow only); and (3) estuarine sections. Equations are given for each case. Generally, numerical solutions are applied to solve real time conditions when there are changes in stream parameters and time considerations. (Hawkins-Omniplan)
W85-06365

INFORMATION FOR STATE GROUNDWATER QUALITY POLICYMAKING,
Oklahoma Univ., Norman. Dept. of Geography.
R. S. Roberts, and L. M. Butler.
Natural Resources Journal, Vol. 24, No. 4, p 1015-1041, October, 1984. 7 Fig, 117 Ref.

Descriptors: *Groundwater, *Drinking water, *Water supply, *Policymaking, Decision making, Planning, Water management, Legal aspects.

An increased concern with the adequacy of regulatory programs to protect groundwater quality has accompanied the growing awareness of the susceptibiltiy of groundwater to contamination. Groundwater quality management continues to be undertaken primarily at state and local levels. The availability of information of the appropriate kind, geographic scale, and organization to effectively apply to policymaking is essential for groundwater quality management by state governments. An approach to developing a groundwater quality information base that relies on land and water use data in contrast to groundwater quality data is described and evaluated. An information base which incorporates resource use data may produce information more useful to the state policy formulation than an information base relying primarily on groundwater quality data. The current emphasis on groundwater monitoring and modeling may therefore be misguided. The limits of conventional groundwater monitoring and modeling are explored. Using examples from New England, an approach is described which is based on resource use data and discusses this approach in terms of cost, timeliness of results, and conceptualization of groundwater problems. The wider applicability of this approach is also considered. (Baker-IVI)
W85-06535

CONTINGENT VALUATION OF WATER POLLUTION CONTROL,
Waikato Valley Authority, Hamilton (New Zealand).
B. S. Harris.
Journal of Environmental Management, Vol. 19, No. 3, p 199-208, October, 1984. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Valuation, *Waikato Basin, *New Zealand, *Water pollution control, Water resource management, Economic aspects, Public participation.

In the management of natural resouces, controlling agencies are often faced with conflicting situations in which an activity is likely to improve the welfare of some people while degrading the welfare of others. The technique of contingent valuation to quantify water quality improvements is a successful means of non-market valuation for New Zealand situations. This technique can be applied to any non-market good or service about which the public has sufficient knowledge to perceive worth. Because of the relatively high cost of undertaking a contingent valuation its use should be restricted to major impacts, i.e. to investigations involving nonmarket impacts that may be significant in major, large scale evaluation. A useful development of the contingent valuation approach is the determination of optimal levels of provision for an environmental good. The controversy associated with the drainage of wetlands considered to be of national and international significance is currently being enacted in New Zealand. The conflict is between drainage, rural development and tangible economic return, and the retention of a valuable natural resource. An indication via contingent valuation of the approximate magnitude of worth of a wetland habitat, in monetary terms reflecting utility, can easily be compared with straight economic return from development. Other possible applications of contingent valuation are the provision or retention of recreation sites, native forests, and fisheries. (Baker-IVI)
W85-06605

HANDBOOK OF ENVIRONMENTAL QUALITY MEASUREMENT AND ASSESSMENT: METHODS AND TECHNIQUES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W85-06897

PROJECT SUCCESS: SENSITIVITY TO PROJECT ASSUMPTIONS, 'THE MEDELLIN CASE',
Dames and Moore, Bethesda, MD.
A. Knepp, and G. E. Wood.
In: Proceedings of Stormwater and Water Quality Model Users Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 1-21, 11 Fig, 13 Ref.

Descriptors: *Model studies, *Computer models, *Water quality, *Hydrological models, *Waste management, *Rivers, *Mathematical models, Baseline studies, Nonpoint pollution sources, Decision making, Project planning, Management planning.

The effect of major planning assumptions on the predicted water quality of the Rio Medellin, a Columbian river which receives untreated sewage loads and large amounts of sediments and solid wastes, was studied using the Qual II model. The sensitivity analysis was accomplished by establishing a 'baseline' condition and examining the effects on baseline quality of modifying a single assumption or group of assumptions. Modifications of the baseline condition included variations in flow, percent wastewater collection, dilution water inflow, nonpoint source inputs, and solid waste contributions. Results showed that, in addition to the extensive point source controls recommended, decision makers should recognize that the implementation of a sewer connection program, the abatement of solid waste, and the provision of dilution water are very important to maintaining quality criteria during critical periods and are therefore important to the success of the project as currently planned. The sensitivity of projected water quality to nonpoint sources and to lower flows than used in the screening of abatement alternatives in this case was small. Preliminary results of a major planning study also indicate that a configuration of four treatment plants sited along the models portion of the Rio Medellin would cost-effectively meet specified water quality criteria.
W85-07000

CONSULTANT'S ROLE IN MANAGEMENT ADVICE FOR WATER UTILITIES,
Camp, Dresser and McKee, Inc., Boston, MA.
C. P. N. Woodcock.
Journal of the New England Water Works Association, Vol. 99, No. 1, p 72-81, March, 1985.

Descriptors: *Water management, *Decision making, *Utilities, Planning, Consultants, Decision making, Audits, Computers.

Water utilities are in the position of having to meet new, more costly requirements while being more responsive to consumer concerns. The pressure to keep costs down is intense. Rising water rates are causing consumers to question water operation more frequently than before. There are numerous ways consultants can assist water utilities in these difficult times. Computer applications for many utility functions are proven aids, and their use will expand. Consultants can be of considerable assistance in identifying the hardware and software best suited to each utility's specific needs. With the use of a computer one can evaluate numerous options that normally would take days, including: different rates of inflation, different increases in growth of consumption, the impact on different customer classes, the impact of a new construction project, and different bond repayment options. Computers are extremely valuable in other technical applications as well as including demonstrating the impact throughout the system of: the placement of a new well, increasing the flow from existing or new sources, an interconnection with another town, optimum pumping schedules, the placement of a new storage tank, enlarging an existing storage tank, the installation of a new transmission main, or the impact of cleaning and lining a pipe vs replacing it. Another area where consultants can be of considerable aid is in the management audit. Generally, an audit will result in a report which details the utility's current practices, describes its strengths and weaknesses, and identifies corrective measures or areas where further analysis is indicated. (Baker-IVI)
W85-07062

NETWORKS PLANNING FOR WATER INVESTIGATIONS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 7A.
W85-07098

6B. Evaluation Process

NEW CANAL ON EUROPE'S MAP: THE DANUBE-BLACK SEA CANAL,
Texas Univ. Health Science Center at San Antonio. School of Public Health
A. Ghenovici.
Revue Roumaine de Geologie Geophysique et Geographie, Vol. 28, p 17-26, 1984. 7 Fig.

Descriptors: *Canals, *Danube-Black Sea Canal, Water resources development, Environmental effects, Construction, Highways, Electrical networks, Flood control, Navigation, Irrigation.

The Danube-Black Sea canal is a construction of national importance to Romania. The project was selected to use relief features and avoid the use of large surfaces of agricultural lands. The canal will be 70-90 m wide at the bottom and 7.0 m deep under normal navigation conditions. Construction on the canal started in 1975. The building of the canal called for a series of modifications in the area, including: relocation of roads, railways, electrical networks, telephone networks, water supply pipes and sewerage systems; an irrigation program; the elevation of flooded land; drainage and embankment works; retention dams; and water regulation schemes. The canal was officially inaugurated on May 26, 1984. (Baker-IVI)
W85-06419

REVIEWING THE STATUS OF CANADA'S AQUATIC RESOURCES,
M. C. Healey.
Water and Pollution Control, Vol. 123, No. 2, p 24-25, 36, March/April, 1985.

Descriptors: *Reviews, *Aquatic environment, *Water resources, *Canada, Symposium, Conferences, Great Lakes, Water pollution control.

The work of the Rawson Academy of Aquatic Science is reviewed. Thus far the Academy, which was created in 1976, has been involved in three major projects. The first is the annual presentation of an award of excellence to a professional who has made a truly significant contribution to aquatic science or management in Canada. The second is a synthesis of the aquatic resource and ecosystem information on the Great Lakes. The third project is a review of the status of Canadian aquatic resources. One aspect of this third project is a national symposium on aquatic resource issues to be held in May of 1985. A series of public lectures derived from information disseminated at the symposium will be designed to communicate the information on aquatic resource issues to a wider audience than the group of professionals likely to attend the symposium. (Baker-IVI)
W85-06429

FLOOD DAMAGE MITIGATION: A REVIEW OF STRUCTURAL AND NONSTRUCTURAL MEASURES AND ALTERNATIVE DECISION FRAMEWORKS,
Wollongong Univ. (Australia). Dept. of Economics.
D. J. Thampapillai, and W. F. Musgrave.
Water Resources Research, Vol. 21, No. 4, p 411-424, April, 1985. 2 Fig, 1 Tab, 113 Ref.

Descriptors: *Decision making, *Flood control, Flood damage, Floods, Reviews, Floodplains, Decision making, Nonstructural alternatives, Economic aspects.

The wide range of decision frameworks which are employed in the formulation of flood mitigation strategies are reviewed. This review includes an understanding of the various flood mitigation measures and their economic significance with attention given to structural and nonstructural measures. Various decision frameworks used in the derivation of flood mitigation strategies discussed include those for use with structural measures alone, including minimization of expected value of flood losses alone, decision frameworks based on linear programming and related techniques, decisions designed to minimize the expected failure of flood losses and the cost of risk taking, and decision frameworks based on stochastic dynamic programming. Decision frameworks for nonstructural measures alone include minimization of only the expected value of flood losses, decision frameworks based on discrete enumeration of costs and benefits. Additional areas considered include the inadequacies of the frameworks, and directions in which formulation of more adequate frameworks may proceed. (Baker-IVI)
W85-06495

MANAGING RIVER SYSTEMS: CENTRALIZATION VERSUS DECENTALIZATION,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4A.
W85-06536

GRAPH THEORY APPLIED TO EVALUATION OF WATER SCIENCES RESEARCH SYSTEMS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Journal of Environmental Systems, Vol. 14, No. 2, p 161-189, 1984-85. 3 Fig, 4 Tab, 46 Ref.

Descriptors: *Evaluation, *Research priorities, Financing, Coherence graphs, Research facilities, Research objectives.

Many procedures have been proposed over the past years for evaluating the degree to which the objectives pursued by research are realized. However, none of these has succeeded in entirely encompassing the problem. Thus, a new approach that is likely to improve on already existing procedures has been sought. After presenting a typology of the diverse methods used in the evaluation process, this article describes a technique which permits one to systematically determine the relationships in a system of research execution and to rapidly identify the principal components. The use of coherence graphs has facilitated the achievement of these objectives. As a case study, the method has been applied to qualitatively describe a system of university research in the water sciences. In the preliminary step, the objectives pursued by university research and the disciplines necessary for realizing projects have been itemized. The second stage involves the construction of a coherence graph by establishing relationships between the elements. A schematic representation of the relationships making up the research system is thus obtained. The graph consists of five levels: objectives, sources of financing, places where research is conducted, programs, and project disciplines. This graphic representation allows one to identify among the multiple requests for funds those that have the greatest potential to provide the desired results in accordance with the objectives retained. (Author's abstract)
W85-06697

ANALYSIS OF ISSUES CONCERNING 'ACID RAIN': REPORT TO THE CONGRESS OF THE UNITED STATES.
General Accounting Office, Washington, DC. Office of the Comptroller General.
GAO/RCED-85-13, December 11, 1984. 185 p, 3

Fig, 7 Tab, 5 Append.

Descriptors: *Decision making, *Acid rain, *Air pollution effects, *Policy making, *Cost-benefit analysis, *Economical aspects, *Environmental policy, *Evaluation, Future planning, Air pollution, Environmental effects, Water pollution control, Water pollution prevention, Water pollution sources, Environmental protection.

Intense debate continues over whether it is time for the United States to take control actions against the environmental effects of acid deposition (acid rain). Acid rain has become an international as well as a national issue because the pollutants involved (oxides of S and N) often travel far from their place of emission across state and even national boundaries. A series of observations of the General Accounting Office are presented which are based on the implications of current scientific knowledge for policy decisions on acid rain. Limited damage caused by transported acid rain has been confirmed in only a few areas of North America to date. Uncertainties about anticipated damage rates make it difficult to predict the need for and effectiveness of control actions. Mitigation actions taken where deposition occurs have limited capabilities and are not economical for large unmanaged areas such as forests. Emission controls, to be effective, would have to be implemented over a wide area. Cost-benefit analysis is of limited value in evaluating the benefits of emission control programs. Changes in the Clean Air Act would have to be made to reorient the goal for acceptable ambient air quality to focus on reducing total regional emission of pollutants. Further scientific work on acid deposition will be needed for a number of years, no matter what decisions are made on control actions in the short term. The alternatives for controlling acid rain and their economic effects are considered.
W85-06944

EFFECT OF ACIDIFICATION DAMAGES ON THE ECONOMIC VALUE OF THE ADIRONDACK FISHERY TO NEW YORK ANGLERS,
Clarkson Univ., Potsdam, NY. Dept. of Economics.
For primary bibliographic entry see Field 5C.
W85-07034

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ECONOMIC, LEGAL AND INSTITUTIONAL RELATIONS INVOLVED IN DIVERSION AND OTHER INTERBASIN TRANSFERS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 6A.
W85-06304

ECONOMIC, LEGAL AND INSTITUTIONAL RELATIONS INVOLVED IN DIVERSION AND OTHER INTERBASIN TRANSFERS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 6A.
W85-06307

MUNICIPAL USE OF EXISTING WELLS FOR SUPPLEMENTAL WATER SUPPLY IN THE PIEDMONT AND BLUE RIDGE PROVINCES OF GEORGIA,
Georgia Univ., Athens. Carl Vinson Inst. of Government.
J. E. Kundell, and R. C. Chambers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157741/AS, Price codes: A06 on paper copy, A01 in microfiche. Environmental Resources Center Report No. ERC 01-84, Georgia Institute of Technology, Atlanta, Georgia, September 1984, 78 p, 1 Tab, 1 Fig, 7 Ref, Project No. USGS G-836 (06).

Descriptors: *Georgia, *Groundwater, *Water low, *Water resources management, Ground water, Municipal water supply, Supplemental water supply, Drought contingency, Emergency supply, Piedmont ground water, Blue Ridge Mountain ground water.

Although the Piedmont and Blue Ridge Mountain provinces of Georgia are usually considered to be dependent on surface water, a great majority of the municipalities in these regions utilize wells for at least a portion of their raw water supply. A problem with expanding ground water systems in these regions is in identifying well sites that will yield relatively large quantities of water. This report examines a nonconventional alternative for providing supplemental water supply in hard rock regions by incorporating privately owned wells in the municipal systems. Consideration is given to the potential occurrence of privately owned high yielded wells in the vicinity of the municipal system, the legal and regulatory requirements that must be addressed in pursuing this nonconventional approach, and technical and economic questions that must be answered by municipalities interested in considering this potential source of water.
W85-06318

EQUITY AND EQUIVALENCE ASPECTS OF EFFLUENT AND OUTPUT TAXES,
Guelph Univ. (Ontario). Dept. of Economics.
D. A. L. Auld.
International Journal of Environmental Studies, Vol. 24, No. 1, p 55-60, 1985. 2 Fig, 7 Ref.

Descriptors: *Taxes, *Water pollution control, *Effluent taxes, Economic aspects, Equity, Waste management.

Two aspects of tax policy for pollution control are highlighted. First, persons in equally situated circumstances (in terms of pollution) are affected unequally by an output tax unless a perfectly efficient solution is followed. If this is not done, then to at least ensure equity a system of subsidies is required. Second, where there exists a cost of abatement schedule, the relationship between an effluent tax and output tax is explicit, provided the link between waste and output is given. To achieve a given level of waste abatement, a smaller effluent tax can be imposed. The choice between the two would appear to depend on compliance, monitoring, the output mix of the firm and political sensitivity to tax impositions. If it is relatively simple to monitor waste, then the effluent tax is probably the best choice for it avoids the necessity of continuous adjustment in the case of the output tax and waste abatement technology changes or the mix of output of the firm changes. (Baker-IVI)
W85-06559

ENGINEERING-ECONOMIC SIMULATION MODEL FOR REGIONAL WASTEWATER TREATMENT COST FUNCTIONS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 5D.
W85-06602

PROCEEDINGS OF SYMPOSIUM ON COST ESTIMATING FOR WATER SUPPLY PLANNING STUDIES.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. Edited by Thomas M. Walski. 117 p.

Descriptors: *Cost analysis, *Cost, *Water supply, *Estimated costs, Estimating, Water policy, Regional planning.

This report contains the papers presented at the symposium 'Cost Estimating for Water Supply Studies' as conducted at the ASCE Specialty Conference, Water Supply: The Management Challenge, in Tampa, Florida, 14-16 March 1983. The proceedings include an overview chapter, description of alternative approaches from the detailed 'systems estimate' to the more general approach of 'parametric estimating.' Other topics include verification of estimating models, spatial cost estimating, estimating for small systems and large regional studies, and a method for estimating surface water intake costs.
W85-06946

PLANNING WATER SUPPLY PROJECTS: THE SYSTEMS ESTIMATE,
Means (R.S.) Co., Kingston, MA.
D. R. Lehigh.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 20-24, 8 Fig.

Descriptors: *Cost analysis, *Costs, *Estimated costs, *Systems estimates, Management planning, Water supply, Water policy.

A systems estimate can obtain a more accurate cost estimate than previously possible using either the 'Order of Magnitude,' the 'Square Foot Estimate,' or the 'Unit Price Estimate'. A system can be described as a composite of several unit price components that are interrelated, each expressed in its own unit of measure, that form a major element of a project, expressed in a common unit of measure. A systems table is composed of similar systems each having the same components, but differing from each other by some design variable such as dimensions, loading, etc. Different systems tables dealing with the same building element may be compared for costs. A numbering system has already been established for systems, called the Uniformat, which contains divisions 1 through 12, from Foundations through Sitework, respectively. A system should be listed within its division by number and the accompanying information; description, quantity, unit of measure, unit cost and total cost, almost as would be seen in a 'Unit Price Estimate'. None of the criteria necessary to select the appropriate sitework systems should require a lot of time. The estimator only needs to identify the design parameters, not complete the design. The Systems Estimate itself, not including pilot plant studies, soil investigation and preliminary information, should take no more than a day to complete.
W85-06947

DEVELOPING WATER UTILITY COST ESTIMATES INCORPORATING SPATIAL FACTORS,
Hackensack Water Co., Harrington Park, NJ.
D. L. Schlenger.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 25-46, 13 Fig, 7 Ref.

Descriptors: *Costs, *Cost analysis, *Estimated costs, *Utilities, Management planning, Water conveyance, Water users.

The objective of this paper is to provide the water supply engineer or planner with some perspectives on the spatial aspects of water supply costs. Specifically, it briefly addresses the relationship between capital and operating costs in the transmission and distribution system and the interaction between costs, prices and usage. Metropolitan water utilities provide two things. They provide a product: potable water. In delivering that water to the customers' premises, they also provide a service: transportation. The greatest portion of operating and capital costs for a water utility results from providing transportation of water to the customer. The cost of providing this transportation service has been growing at an alarming rate in recent years due to rising energy costs. As a result, the differences from one location to another in the distribution system in the cost of providing water have become more acute. Cost estimates that recognize these spatial differences are important for: 1) Long run capital planning of the transmission and distribution system; 2) Energy management programs to minimize operating costs while maintaining adequate pressure throughout the distribution system; and 3) Rate setting when rates can vary from one location to another. Finally, it discusses an approach to analyzing operating cost data so as to assess the impact of capital expenditures.

W85-06948

VERIFICATION OF MAPS COST ESTIMATING PROCEDURES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski, and A. K. Linsey.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 47-57, 1 Fig, 8 Ref.

Descriptors: *Cost analysis, *Costs, *Estimated costs, *Systems analysis, Management planning, Regional planning, Long-term planning, MAPS.

The purpose of this study was to verify the MAPS costs estimating procedure against an independently determined set of cost data. From this kind of analysis it is possible to: a) determine the accuracy of the individual modules, b) identify and correct minor shortcomings of the program, and c) identify potential major program modifications and additions. The geometric mean percent error for the 35 facilities was 13.9%. Existing guidance in Corps of Engineers regulations and manuals on cost estimating indicates that estimates are considered accurate if they fall within 25% of actual costs. The MAPS cost estimates for 75% of the facilities fall within this 25%-range. The cost estimate for only one facility differs by more than 50%. The correlation coefficient between actual and MAPS costs was 0.967. Comparison of the MAPS cost functions with other cost functions showed a high degree of consistency. As a result of this study, many of the shortcomings of the program were identified and corrected. In the case of water treatment plants, the program has been upgraded independently since this study.
W85-06949

ESTIMATION OF COSTS FOR SMALL WATER SYSTEMS,
Weston (Roy F.), Inc., West Chester, PA.
A. K. Deb, and W. G. Richards.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 58-74, 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Cost analysis, *Costs, *Water supply, *Estimated costs, Management planning, Water delivery, Water distribution.

The WATer MANagement (WATMAN) model has been expanded in this study so as to cover both large and small water systems. It is a particularly versatile tool for estimating preliminary design costs for small water systems as data appropriate to small systems and alternative technology, especially for bottled water distribution and point-of-use treatment, was collected and used to derive cost information. Cost functions for estimating capital and operations for small water systems have been developed and incorporated into the model. WATMAN is flexible enough to simulate almost any configurations of up to ten water systems and a variety of unit processes in order to conduct preliminary designs and economic evaluations of alternative technologies available to utilities. Several technologies considered especially appropriate to small systems were examined including alternate sources, conventional additional treatment, package plants and equipment, regionalization, and dual water systems, point-of-use treatment, and bottled water distribution.
W85-06950

DEVELOPING COST ESTIMATING METHODS FOR SURFACE-WATER INTAKE STRUCTURES,
Weston (Roy F.), Inc., West Chester, PA.
K. Cable, and J. S. Condra.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 75-91, 10 Fig, 1 Tab, 8 Ref.

Descriptors: *Cost analysis, *Costs, *Estimated costs, Intake gates, Management planning, Surface water, Intakes.

Surface-water intake structure design is highly site-specific and hence the costs depend on a large number of variables. A simple correlation of intake cost with design flow or total system cost will not provide accurate estimates due to the variability in designs for the intake system. Therefore, a more complex procedure involving several site-specific characteristics is needed to estimate reasonable costs for surface-water intakes. Presented in this paper are: 1) existing approaches for developing planning level cost estimated for intake structures and/or raw water pumping facilities, 2) the procedure developed by the authors for preparing quick estimates, 3) comparisons of costs generated by this method with costs of actual projects, and 4) implications of the estimating procedure. This method can generate reasonably accurate planning level cost estimates with minimal effort, and allows for a wider application of the estimation procedure than previously developed procedures.
W85-06951

APPLICATION OF PARAMETRIC ANALYSIS TO WATER SUPPLY,
H. K. Burbridge.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 92-112, 9 Fig.

Descriptors: *Parametric analysis, *Cost analysis, *Costs, Water supply, Estimated costs, Management planning.

The purpose of this paper is to introduce the parametric analysis concept as it may apply to water supply, and its use as a management tool of considerable power. Models presented are: 1) ESTEK, 2) FAST-C, 3) FAST-E, and 4) Hayes, Seay, Mattern and Mattern (HSMM), with mention of the possible applications of these models to various government and private sector projects.
W85-06952

COST ESTIMATING FOR REGIONAL WATER SUPPLY STUDY,
Benham Group, Inc., Oklahoma City, OK.
M. D. Lee.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 113-117.

Descriptors: *Costs, *Cost analysis, Estimated costs, Management planning, Regional planning.

The purpose of this paper was to examine the issues relating to water resources and to develop multipurpose plans for solving problems, such as flooding and inadequate water supplies in the metropolitan Tulsa, Oklahoma region. The planning process was an iterative one of formulating alternative plans, evaluating them, revising the alternatives, reevaluating them until the best plan could be identified. The cost evaluation was accomplished by means of a computer program entitled Methodology for Areawide Planning Studies (MAPS). The resulting estimates included capital costs as well as the costs of operation and maintenance. The pipeline costs were calculated for an array of pipe diameters in order to minimize the sum of the capital cost and the operating cost. The final estimates were realistic and accurate, and the use of the program permitted investigation of a large number of alternatives. The final report included plans that would best serve the supply needs of the Tulsa Urban Study area, using existing and potential water supply sources within a reasonable distance of the area.
W85-06953

PLANNING LEVEL COST ESTIMATING: SCIENCE, ART, OR WITCHCRAFT,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski.
In: Proceedings of Symposium on Cost Estimating for Water Supply Planning Studies, March 14-16, 1983, Tampa, Florida. Miscellaneous Paper EL-83-6, September 1983. Final Report. p 5-19, 6 Fig, 41 Ref.

Descriptors: *Cost analysis, *Costs, *Water supply, *Estimated costs, Management planning, Estimating, Planning.

Planning level cost estimating is defined, its characteristics are described, and the phases of preparing a planning level estimate and the interactions between the phases are discussed. The problem of tradeoffs between detail and accuracy is analyzed, cost functions and the data used in preparing them are presented and, finally, the relationship between planning and estimating is discussed. Development of a planning level cost estimate is a different process than development of estimates based on detailed plans and specifications. Because it is part of an iterative process, planning level estimating requires an approach that yields estimates quickly and reproducibly while accounting for the effects of the most important design parameters. Some guidelines are presented in this paper for developing cost functions.
W85-06954

6D. Water Demand

CONSUMER ATTITUDES TOWARD PUBLIC WATER SUPPLY QUALITY: DISSATISFACTION AND ALTERNATIVE WATER SOURCES,
Southern Illinois Univ. at Carbondale.
L. L. Curry.
Illinois State Water Survey Circular 158, 1983, 31 p, 9 Tab, 64 Ref. 1 Append.

Descriptors: *Public opinion, *Attitudes, *Operating policies, *Taste, *Odors, *Drinking water, *Potable water, *Water quality management, *Water quality standards, Marketing, Fluoridation, Fluorides.

Consumer attitudes were surveyed to determine their perception of drinking water quality. Bottled water buyers and home water treatment unity users were polled to discern what led these consumers to reject or alter the available public drinking water. Analysis of the data reveals that those in the control group (who used neither bottled water or home units) stated most often that they were satisfied with the quality of their drinking water. Fifty-eight percent of the control group responded positively, as compared to the bottled water group, of which 75.8 percent stated that they were not satisfied. Similarly, 78.4 percent of the home unit group expressed dissatisfaction with water quality. When queried about the reasons for their decision to buy bottled water or a home filter unit, 57.6 percent of the bottled water group and 39 percent of the home unit group responded that it was for health reasons. About one-third of both the bottle water and the home unit groups stated that the high salt content of public water led them to purchase alternative water sources. Nine percent of the bottled water group, 2.0 percent of the home unit group, and 4.7 percent of the control group considered fluoride addition to be a problem and 12.1 percent, 9.8 percent, and 18.6 percent, respectively, considered chlorine treatment to be detrimental to health. The bottled water and home filter buyers also designated taste, odor, hardness and color as factors in their dissatisfaction with public water supplies. (Hawkins-Omniplan)
W85-06347

TRANSFER FUNCTION MODELS OF DAILY URBAN WATER USE,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. R. Maidment, S.-P. Miaou, and M. M. Crawford.
Water Resources Research, Vol. 21, No. 4, p 425-432, April, 1985. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Water use, *Urban areas, *Austin, *Texas, *Model studies, Rainfall, Air temperature, Seasonal variation.

A time series model of daily municipal water use as a function of rainfall and air temperature is developed. Water use data from 1961 to 1981 in Austin, Texas indicate that base use constitutes three fourths and seasonal use one fourth of the total annual volume of water used. Base use comprises 40% and seasonal use 60% of the peak daily water use rates. In Austin, a change in base use occurred in 1970 which was equivalent to two and a half years of normal growth in base use at that time. Daily water use data from 1975 to 1981 in Austin indicated that seasonal water use is nonlinearly related to air temperature. For the Austin daily water use the effect of a rainfall on a given day is to cause a drop in that day's seasonal water use to 40% of the previous day's use, if the rainfall amount is greater than 0.05 inches. The complete model describes 97% of the variability of daily water use data, much more than reported in any other daily water use study. (Baker-IVI)
W85-06496

MUNICIPAL DEMAND FOR WATER IN KUWAIT: METHODOLOGICAL ISSUES AND EMPIRICAL RESULTS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Agricultural Economics and Rural Sociology.
M. H. Al-Qunaibet, and R. S. Johnston.
Water Resources Research, Vol. 21, No. 4, p 433-438, April, 1985. 1 Fig, 4 Tab, 42 Ref.

Descriptors: *Water demand, *Kuwait, Municipal water, Water conservation, Public participation, Pricing, Water conservation, Utilities, Costs.

This study employed the use of a demand function for municipal water derived from the Stone-Geary utility function, thereby permitting explicit consideration of the minimum amount of water necessary for daily needs. The study revealed that even in an oil-rich country like Kuwait, people do respond to changes in the prices of public services, at least in the case of municipal water. Thus, in a country which is largely dependent on an expensive source of fresh water supplies, namely, desalination of sea water, the price of municipal water may be an effective tool that the water utility can use to control water consumption. Doing so will help reduce or defer system expansion, reduce pumping costs, and increase the life of present supplies. It is estimated that the subsistence water use level in Kuwait is about 42 L per capita per day and the results suggest that people will be cooperative in conservation until that level is reached. (Baker-IVI)
W85-06497

EFFECTS OF INSTREAM FLOW REQUIREMENTS ON WATER SUPPLY RELIABILITY,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. N. Palmer, and R. M. Snyder.
Water Resources Research, Vol. 21, No. 4, p 439-446, April, 1985. 11 Fig, 1 Tab, 19 Ref. Dept. of the Interior project 143-34-10E-3391-3074.

Descriptors: *Water supply development, *Water management, *Instream flow requirements, *Water demand, Water supply, Model studies, Computer models, Simulation, Reservoir capacity.

To evaluate the impacts of instream flow requirements (IFR) on municipal water supply performance a computer simulation model was used with synthetic inflow sequences to investigate changes in indices of system performance with various instream flow and management strategies. This study indicates that instream flow requirements have significant impact on the ability of a municipal water supply system to meet water demands. Depending on the quantity of the requirement and the existence of other demands, the impact can decrease the performance of the system by an order of magnitude. For the water supply system examined, reservoir capacity expansion greatly improved the ability to supply municipal water demands. Such expansions are costly. The establishment of IFR should be considered in this socioeconomic context. The benefits accruing from IFR are not quantifiable in economic terms under the current IFR methodology. This places those responsible for establishing reasonable and prudent IFR in a difficult situation in prescribing restrictions that may have significant economic impacts with little economic justification. The indices suggested for determining the impacts of IFR are flexible and provide alternative evaluations of the information. (Baker-IVI)
W85-06498

CLIMATIC CONSTRAINTS TO WATER RESOURCE DEVELOPMENT IN THE SUDANO-SAHELIAN ZONE OF NIGERIA,
Bayero Univ., Kano (Nigeria). Dept. of Geography.
E. A. Olofin.
Water International, Vol. 10, No. 1, p 29-37, March, 1985. 2 Fig, 6 Tab, 22 Ref.

Descriptors: *Nigeria, *Water resources development, *Climatic zones, *Sudano-Sahelian zone, Tropical regions, Developing countries, Rainfall, Wind, Water conservation, Evapotranspiration, Drought, Dam construction.

Climatic variables, particularly rainfall and evapotranspiration, constitute great constraints to both natural water availability and water resource development in the Sudano-Sahelian zone of Nigeria. The climatic variations and drought conditions which constitute the greatest climatic constraints in the zone cannot be eliminated, and their occurrences cannot be predicted accurately. It is for this reason that water resource development (both ground and surface) becomes highly essential in minimizing the water deficiency and hardships which usually accompany the variations and droughts. The development of water resources through the construction of dams, reservoirs, canals, wells and boreholes is also adversely affected by certain climatic variables. The effects of these phenomena can be minimized through better designs of dams, reservoirs and canals to check excessive evaporation from these water bodies, and through catchment area protection, as well as other conservational techniques, to check the effect of high rainfall and wind intensities. When these measures are taken, the effects of the climatic constraints on water resource development in the zone will have been minimized to a tolerable level. (Baker-IVI)
W85-06546

PHARMACOPEIA REQUIREMENTS AND WATER STANDARDS IN THE UNITED STATES OF AMERICA,
Vaponics, Inc., Plymouth, MA.
V. C. Smith.
Journal of Environmental Sciences, Vol. 27, No. 6, p 21-26, November/December, 1984. 10 Fig, 11 Ref.

Descriptors: *Water quality control, *Requirements, *United States Pharmacopeia, Standards, Public health, Pharmaceutical industry, Water treatment.

The standards for the various types of water to be used by the pharmaceutical industry are set by governmental agencies and consensus standards committees in the United States. Essentially, all of these different standards are drawn up as a result of the agreement of technical committees made up of representatives of the various government agencies, scientific institutions and industrial representatives on the technical committees. Since all of the standards related to water purity involve the removal of contaminants, these contaminants are described and the method of removal discussed briefly. These methods include distillation, demineralization, reverse omsosis, ultrafiltration and membrane filtration, adsorbants and prefiltration. Various test procedures recognized as methods of testing for various impurities are noted with specific reference to pyrogen detection. There are various grades of water specified by the regulations of the Food and Drug Administration as promulgated by the US Pharmacopeia XX. These grade include water for injection, bacteriostatic water for injection, sterile water for inhalation, sterile water for injection, sterile water for irrigation, and purified water. Requirements which must be met by the distribution piping systems are noted. (Baker-IVI)
W85-06627

CROP WATER REQUIREMENTS FOR RAINFED AND IRRIGATED WHEAT IN CHINA AND KOREA,
California Univ., Los Angeles. Dept. of Geography.
W. H. Terjung, H.-Y. Ji, J. T. Hayes, P. A. O'Rourke, and P. E. Todhunter.
Agricultural Water Management, Vol. 8, No. 4, p 411-427, February, 1984. 10 Fig, 1 Tab, 24 Ref.

Descriptors: *Water requirements, *Irrigation requirements, *Wheat, *China, *Korea, Water use, Model studies, Climate, Evapotranspiration, Optimization, Sensitivity analysis.

The parametric crop water use model (WATER) was applied for winter wheat to China and its environs in order to examine the evapotranspiration requirements under rainfed conditions and the associated irrigation water applications necessary for optimal production. A network of 241 stations provided climatic data averaged over a 20 year period. Highest ET under full irrigation (first growing season) was observed in the north-western inland sections of China and the eastern portions of the Tibetan Plateau, while lowest ET occurred in the southeast; under rainfed conditions, these tendencies nearly reversed. About 400 mm of irrigation water was required in the northwest in order to achieve near-optimum yields in contrast with no such water requirements in the central east of China. A sensitivity analysis was conducted to determine the errors introduced by faulty, uncertain, or missing station data. (Author's abstract)
W85-06687

HANDBOOK ON THE BISCAYNE AQUIFER WATER MANAGEMENT, WATER CONSERVATION HEALTH AND COST OF DRINKING WATER.
Environmental Coalition of Broward County, Inc., Fort Lauderdale, FL.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118539. NSF/OSS-82002, 1982. National Science Foundation, Washington, DC. Brion Blackwelder, Brenda Marinace, and Joseph E. Podgor, editors. 192 p, 1 Fig, 4 Tab, 30 Ref. Contract/Grant No. OSS727074.

Descriptors: *Water supply, *Water demand, *Water management, *Planning, *Water resources development, *Water pollution, *Water quality, Biscayne Aquifer, *Florida, Aquifers, Groundwater, Water conservation, Okeechobee Lake, Everglades, Drinking water, Groundwater pollution, Water use, Urban areas, Agriculture, Irrigation, Water policy, Municipal water, Public health, Water treatment, Standards, Water analysis, Regulations, Water costs.

Information is presented from scientists, planners, and citizens concerning water resources in southeast Florida. Local groundwater and the Everglades-Okeechobee system are described and pollution of local groundwater, water consumption by urban and agricultural areas, methods of water conservation inside and outside the home, and the sharing of water resources with natural systems are discussed. The problems of growth and water supply are assessed, as are water standards, especially those relating to carcinogens such as trihalomethanes. Tap water, bottled water, home treatment units, vended water, and the cost of water from alternative sources are examined. (Author)
W85-06906

SAHEL: THE CHANGING RAINFALL REGIME AND THE 'NORMALS' USED FOR ITS ASSESSMENT,
Missouri Univ.-Columbia. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 2B.
W85-07066

6E. Water Law and Institutions

CONSTRAINTS ON WATER-RESOURCE DEVELOPMENT IN ENGLAND AND WALES: THE CONCEPT AND MANAGEMENT OF COMPENSATION FLOWS,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
J. Sheail.
Journal of Environmental Management, Vol. 19, No. 4, p 351-361, December, 1984. 24 Ref.

Descriptors: *Water resources development, *Compensation flows, *England, *Wales, Legal aspects, Reservoir operation, Institutional constraints, Legislation.

Reservoirs have always been regarded as one of the most striking forms of resource development and environmental change. By reference to a wide variety of agreements reached over the levels and methods of compensation discharge, the paper illustrates how the concept of compensation flow was first perceived and introduced to reservoir management, and how it was developed and implemented subsequently. In doing so, the paper will demonstrate how engineering and environmental data were acquired and used within the prevailing institutional framework for scrutinizing such questions over the last 150 years. (Author's abstract)
W85-06178

TREATING WATER INSTITUTIONS AS ENDOGENOUS VARIABLES: DEMONSTRATION OF A CONCEPTUAL MODEL,
Economic Research Service, Fort Collins, CO. Natural Resource Economics Div.
M. L. Livingston.
Water Resources Bulletin, Vol. 21, No. 1, p 23-29, February, 1985. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Institutional constraints, *Conceptual models, *Water rights, Legal aspects, Regulation, Water allocation, Water use, Economic aspects, Public policy, Colorado, Instream use, Legislation.

Institutional innovation is central to many water resource problems. (In this context 'institutions' refers to the laws and regulations governing water allocation and use.) Yet, typically, economic analyses treat institutions as exogenous and fixed. Unfortunately, this conventional assumption does not allow economists to address many modern problems. This paper develops an economic framework in which institutions are treated as endogenous. The model accounts for (1) factors that stimulate calls for formal institutional change, (2) the role of interest groups in policymaking, and (3) actual institutional change as it impacts choice domains and thus economic performance. The model is compared to a specific case of change in Colorado's water institutions, namely, instream water rights legislation in the 1970's. The empirical evidence is generally consistent with model hypotheses. The model promises to be useful to scholars and policymakers interested in institutional innovation. (Author's abstract)
W85-06235

DINOSAUR NATIONAL MONUMENT: THE EVOLUTION OF A FEDERAL RESERVED WATER RIGHT,
Environmental Management Support, Silver Spring, MD.
N. J. Bassin.
Water Resources Bulletin, Vol. 21, No. 1, p 145-149, February, 1985. 6 Ref.

Descriptors: *Water rights, *Dinosaur National Monument, *Colorado, Instream flows, Natural flow doctrine, Minimum flow, Legal aspects, National parks.

Dinosaur National Monument, in northwestern Colorado, has become a test case in the establishment of a federal reserved water right to instream flows. For the first time, the Interior Department was forced to rigorously defend its claims in a watershed where the federal government did not control the upstream reaches. Inadequate quantification of minimum flow requirements, court orders, and an apparent Congressional ban on the spending of Water Resources Program funds by the Park Service to quantify its water rights have already placed the Service in a difficult position to protect instream flows for maintaining the ecological integrity of the Monument. As late as 1983, administrators of the Park Service were divided over their legal strategy, many wanting to pursue a policy of claiming 'natural, historic' flows rather than 'minimum' flows. The conditional right to instream flows granted to the Park Service in 1978 was subject to quantification within five years. That deadline has been extended, but it is not likely that the case will reach final settlement this decade. Until the design and conduct of federal water rights quantifications better integrate public policy and law with science, the principle lesson from Dinosaur may have to be repeated. (Author's abstract)
W85-06248

EVALUATION OF LEGAL AND INSTITUTIONAL ARRANGEMENTS ASSOCIATED WITH GROUND WATER ALLOCATION IN THE MISSOURI RIVER BASIN STATES,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
D. J. Aiken.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-161404/AS, Price codes: A05 in paper copy, A01 in microfiche. Project Completion Report, Nebraska Water Resources Center, Lincoln, Dec 1984. 88 p. Project No. BuRec C-80138-P, Contract/Grant No. 14-34-0001-8412 (3).

Descriptors: *Missouri River Basin, Nebraska, Groundwater, *Groundwater management, *Legal aspects, *Institutional constraints, Water law, Resource allocation, Administrative agencies, Groundwater allocation, Groundwater law, Groundwater administration.

Key ground water allocation issues include: (1) the legal theory for allocating and acquiring ground water rights; (2) well interference conflict resolution policies; (3) ground water depletion policies; (4) resolution of conflicts between surface and ground water users; and (5) integration of water allocation and ground water quality protection policies. In most Missouri river basin states a state license or permit is required before ground water can be used for most purposes. By denying or conditioning the permit, the state can control ground water development and use. Well interference conflicts (and to a lesser degree, groundwater depletion and surface-ground water conflicts) are anticipated in many basin states by conditioning ground water permits with requirements limiting interference with existing ground water users. Ground water depletion policies are not well defined, although several states legislatively prohibit withdrawals exceeding ground water recharge. Several basin states have 'critical area' legislation which allows special regulation of ground water development and use when ground water depletion is occurring. Surface-ground water conflict resolution policies are anticipated to some extent in some basin states by conditioning ground water use permits with requirements limiting interference with existing surface water uses. Most basin states protect ground water quality through well drilling regulations. Several states also have well abandonment and check valve requirements.
W85-06300

INTERORGANIZATIONAL RELATIONS AND DECISION MAKING AMONG SECTION 208 WATER QUALITY MANAGEMENT PLANNING AGENCIES,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
H. R. Potter, and H. M. Schweer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 161420/AS, Price codes: A04 in paper copy, A01 in microfiche. Partial Completion Report, Technical Report No. 165, May 1984. 62 p, 13 Tab., 19 Ref, Project No. OWRT C-00090-U(4), Contract/Grant No. 14-34-0001-0498.

Descriptors: Water quality management, *Institutions, Water quality, *Water law, *Indiana, Planning.

This is a study of mandated interorganizational relations (IOR). This is in contrast to most IOR studies that have assumed voluntary relations among organizations. Specifically the focus is on organizations involved in a federally mandated water quality management planning program. Data are from interviews with 39 persons in 33 organizations in three loci: (a) a designated planning area, (b) a non-designated planning area and (c) persons in positions with state wide responsibilities. The greatest involvement was in the designated area, among state and federal organizations, and among agricultural and environmental voluntary organizations. There was little involvement by local government and industry. Multi-level organizations were more committed to public participation, were most likely to get additional program funding and to participate in joint programs than single level organizations. There was considerable variation in interorganizational relations. Information sharing was frequent, and was positively related to incompatibilities with other organizations. Resource sharing and joint programming were less frequent, and were positively related to each other. Commitment to public participation was positively related to the number of contacts with other organizations. The number of organization staff available to work on the program was a greater problem than staff expertise. Length of time necessary for program planning and implementation, continuity and sources of funds, and local support are three major factors that stand out as important to modify in fed.-state-local relations in future programs.
W85-06305

MODEL CODE ON PLANNING FOR AND ALLOCATIONS OF WATER TO PUBLIC WATER SYSTEMS,
East Tennessee State Univ., Johnson City. Dept. of Environmental Health.
V. A. Sikora.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157584/AS, Price codes: A05 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center, Tennessee University, Knoxville, Technical Completion Report 96, UT Pub. no. R01 2550-29-003-84, January 1984. 91 p, Project No. BuRec B-055-Tenn (1), Contract/Grant No. 14-34-0001-1266.

Descriptors: *Resource allocation, *Water allocation, Water law, Financing, *Tennessee, 208 Planning Process, Institutional constraints, Water supply, Administrative regulation, Planning, Governmental initiations.

The purpose of this study was to produce a model code on the state, regional and local planning for and allocation of water to Tennessee public water systems. The method of code construction began with a thorough review and evaluation of federal and state statutes, common law and regulations affecting model code with a narrative interpretation was then prepared incorporating provisions assuring adequate water supplies and encouraging water conservation and reuse, providing planning guidelines and authority to manage the available water sources, and requiring coordination with other federal and state water resource planning agencies. Later the draft was reviewed by a number of state, regional and local officials. The final code is a blend of effective water planning and management provisions and concepts from other states. Incorporated into the code are state and regional planning provisions, and enforcement of water supply development and expansion based on the plans. Water conservation and reuse are required throughout the code. Also water shortage and emergency management authority is created and delegated to appropriate bodies.
W85-06309

MUNICIPAL USE OF EXISTING WELLS FOR SUPPLEMENTAL WATER SUPPLY IN THE

PIEDMONT AND BLUE RIDGE PROVINCES OF GEORGIA,
Georgia Univ., Athens. Carl Vinson Inst. of Government.
For primary bibliographic entry see Field 6C.
W85-06318

STATE WATER LAW: LEGAL ALTERNATIVES AND CONSEQUENCES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Water Resources Research Center.
W. R. Walker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157840/AS, Price codes: A19 in paper copy, A01 in microfiche. Completion Report, (1984). 443 p, Project No. BuRec B-129-VA (1), Contract/Grant No. 14-34-0001-1274.

Descriptors: *Water allocation, *Water law, *Water management, *Water permits, Water policy, Water rights, Legal aspects, Water use, Reasonable use, Consumptive use, Water quality management, Well regulations, *Virginia.

Virginia's water law, especially its water quantity management framework based on the common law riparian doctrine, is an inadequate legal structure for responding to problems caused by rapid changes in population and technology. This report presents a series of legislative alternatives for modifying Virginia's administrative structure for water management, establishing a permit system for consumptive uses, regulating the construction and operation of wells, and protecting water quality. Many of the provisions in the proposed water management framework are modifications of tried and tested permit systems in other eastern and western states, such as Florida, Iowa, Mississippi, and Washington. Brief commentaries follow many of the proposed legislative alternatives, and 12 background appendices provide additional information on the concepts discussed in the report, such as water management districts, the public trust doctrine, the reasonable-beneficial use standard, and administrative water rights inspection.
W85-06327

WATER CODE OF THE BASIN.
Delaware River Basin Commission, West Trenton, NJ.
October 1982. 67 p. 2 Fig.

Descriptors: *Delaware River Basin, *Water use, *Water control, *Conjunctive use, *Government interrelations, *Jurisdiction, *Regional planning, *Legal aspects, Competing use, State jurisdiction, Federal jurisdiction, Political aspects, Interagency cooperation.

The Delaware River Basin Commission consists of representatives of the federal government and the states of New Jersey, Delaware, New York, and Pennsylvania. Maryland is also within the jurisdiction of the commission but is not a signatory state. The water code is comprised of both policy and specific water quality standards. Section 1.1 of the code sets forth the fundamental intergovernmental relations for planning of projects, while Section 1.10 sets forth the policy against which specific projects must be tested for inclusion within the Comprehensive Plan. Article 2 sets forth the basic policies required for the conservation, development, and utilization of the water resources of the Delaware River Basin. These policies include the commission's role in federal water supply projects and its repayment obligations for the non-federal share of the federal investment cost of such projects. Legal entitlements and charges for water are explained. Legislatively mandated goals are set forth in Article 3. Other sections of the code establish the commission's policy on water quality, use and protection of underground waters, and environmental review of projects. Some policies adopted by the commission are used to test projects which may be proposed by any person or agency, and are subject to review under Section 3.8 of the compact. An example are those policies relating to regional approaches to waste treatment. Administrative guidelines are in separate administrative manuals. (Hawkins-Omniplan)
W85-06335

SPECIAL GROUNDWATER STUDY OF THE UPPER DELAWARE RIVER BASIN, STUDY AREA III, VOLUME II.
Wright (R.E.) Associates, Middletown, PA.
Report (1982). 79 p. 3 Fig, 71 Ref, 1 Append.

Descriptors: *Delaware River Basin, *Groundwater management, *Water use, *Legal aspects, *Riparian rights, *Competing uses, *Pumping, *Groundwater level, *Property rights, *Groundwater mining, Water supply development, Drawdown, Selective withdrawal, Water management, Regional planning.

Currently, about 1,000 mgd of groundwater is pumped from wells within the Delaware River Basin. The quantity of groundwater extracted in an average year exceeds the average annual flow of the Lehigh River near White Haven, PA. In the eastern U.S., surface water law and management have historically been based upon the doctrine of riparian rights, in which all land owners adjacent to a body of surface water have equal water rights. Today there are conflicts due to variation in laws and policies toward the use of groundwater in the basin. The special studies of Areas I, II and III of the basin have shown that overproduction, or groundwater mining, has occurred in some portions. A commonly employed management tool involves setting maximum drawdown limits within either individual wells or wellfields to establish conditions beyond which the water resources will not be depleted. This type of restriction could be used to maintain a certain hydraulic gradient that would not induce groundwater flow from areas of poor water quality. Regulation of groundwater use can be achieved by restricting the well density within a groundwater basin. Groundwater associated with mine pools, being a potentially viable resource that could be used for low-flow augmentation, should be examined to determine its true potential. The most practical means of implementing a unified groundwater regulatory system within the basin is to institute a basinwide groundwater mangement plan. (Hawkins-Omniplan)
W85-06338

MARINE POLLUTION UNDER THE LAW OF THE SEA CONVENTION,
Queen Mary Coll., London (England).
A. E. Boyle.
American Journal of International Law, Vol. 79, No. 2, p 347-372, April, 1985. 150 Ref.

Descriptors: *Legal aspects, *Water pollution control, *Marine environment, *Law of the Sea Convention, Regulations, Enforcement, Standards, International law.

Three elements of the Law of the Sea Convention as its relates to marine pollution are examined: the distribution, content and control of prescriptive jurisdiction; the attribution of competence to enforce applicable standards; and the allocation of risk through principles of state responsibility and related concepts of liability, notification and intervention. These issues are central to the development of the new concept of a duty to protect and preserve the marine environment and to any attempt to evaluate the adequacy and completeness of the Convention's approach to marine pollution. The primary significance of the pollution provisions of the Law of the Sea Convention is their formulation of structure of principles governing all aspects of marine pollution prevention and control. Based on the general duty of protecting and preserving the marine environment, this structure is comprehensive as to sources and forms of pollution and in requiring states to take all necessary measures to prevent, reduce and control marine pollution. In addressing issues of regulation, enforcement and cooperation, it reflects a fundamental shift from power to duty as the central controlling principle of the legal regime of the marine environment, and a transition from a regime based on obligations of responsibility for damage to one based on obligations of regulation and control. (Baker-IVI)
W85-06366

NONTRIBUTARY, NONDESIGNATED GROUND WATER: THE HUSTON DECISION,
T. Rice.
University of Colorado Law Review, Vol. 56, No. 1, p 135-156, Fall, 1984. 134 Ref.

Descriptors: *Groundwater, *Colorado, *Nontributary groundwater, Legal aspects, Legislation, Prior appropriation, Water allocation.

In the Huston decision the Colorado Supreme Court held that the state's nontributary, nondesignated (or S.B. 213) groundwater is not subject to prior appropriation. By rejecting the constitutional doctrine traditionally followed in allocating surface and tributary waters, the court acknowledged that nonrenewable groundwater must be protected from rapid depletion. Yet Huston added nothing substantive to Colorado water law. The court created no comprehensive plan to control the resource. Instead the court perpetuated the haphazard regulatory system responsible for today's confusion in Colorado groundwater management. This Note argues that the Colorado General Assembly must act immediately to conserve S.B. 213 water. Current state law neither adequately protects vested rights nor defines procedures for acquiring rights to S.B. 213 reserves. First, an examination is offered of the historical developments which resulted in the Huston decision. The legislative action that followed the case is then considered along with arguments that the legislature must reform the current regulatory scheme for all nontributary, nondesignated ground water. (Baker-IVI)
W85-06367

REGULATING HAZARDOUS AND MIXED WASTE AT DEPARTMENT OF ENERGY NUCLEAR WEAPONS FACILITIES; REVERSING DECADES OF ENVIRONMENTAL NEGLECT,
Natural Resources Defense Council, Inc., Washington, DC.
B. A. Finamore.
Harvard Environmental Law Review, Vol. 9, No. 1, p 83-141, 1985. 351 Ref.

Descriptors: *Hazardous wastes, *Waste disposal, *Radioactive wastes, *Regulations, Environmental effects, Legal aspects, Waste management.

The continuing battle over the regulation of mixed waste water appears to be the latest conflict in a decades-old struggle by the Department of Energy (DOE) and its predecessor agencies to shield their waste disposal practices from outside regulation. DOE operates approximately 30 different nuclear weapons facilities areound the US, ranging from relatively small weapons conponent production plants to major multipurpose operations located on reservations covering more than 500 sq mi. The evolution of the regulatory scheme for managing hazardous and mixed waste at DOE nuclear weaspons facilities is described. The arguments presented in Legal Environmental Assistance Foundation (LEAF) v Hodel are summarized and the district court's opinion in the case is discussed. DOE's current implementation of the LEAF v. Hodel decision is analyzed, with particular emphasis on the regulation of mixed wastes. (Baker-IVI)
W85-06528

JUDICIAL RECOURSE AGAINST FOREIGN AIR POLLUTERS: A CASE STUDY OF ACID RAIN IN EUROPE,
Harvard Law School, Cambridge, MA.
M. Pallemaerts.
Harvard Environmental Law Review, Vol. 9, No. 1, p 143-209, 1985. 281 Ref.

Descriptors: *Acid rain, *Legal aspects, *International law, Air pollution, Litigation, Torts, United Kingdom, Norway.

The opportunities for private litigation by acid rain victims in European countries against foreign sources of long-range transboundary air pollution is explored. Such private actions would aim not only to secure compensation or injunctive relief, but also to establish the illegality of transboundary air pollution, to draw public attention to the mag-

nitude of acid rain damage, and to increase pressure on the involved governments to reach effective solutions. Public international law on transfrontier pollution is discussed generally and long-range transboundary air pollution specifically to see if it could be usefully invoked in private actions. The rules of private international law are examined as they relate to transnational torts and the domestic rules of tortious liability of two European countries, the United Kingdom and Norway, which have been selected because of their primary importance of the acid rain issue in Europe. (Baker-IVI)
W85-06529

ENDANGERED SPECIES ACT AND WESTERN WATER RIGHTS,
Chicago-Kent Coll. of Law, IL.
A. D. Tarlock.
Land and Water Law Review, Vol. 20, No. 1, p 1-30, 1985. 142 Ref.

Descriptors: *Water rights, *Endangered Species Act, *Legal aspects, Legislation, Clean Water Act, Federal jurisdiction, Property rights, Beneficial use.

Like many environmental laws, the Endangered Species Act is paradoxical. If its scientific justification is correct, movement should be occurring towards institutions that practice integrated ecosystem management on a wide geographical scale instead of concentrating efforts on the protection of an arbitrary and limited number of species and their habitats. The integration into western water law of the values represented by the Endangered Species Act and section 404 of the Clean Water Act will not be easily accomplished. The first step is to recognize that it is legitimate for the federal government to claim water rights under these acts. These acts represent a federal decision to add to the list of beneficial uses served by the water resources. The issue is not whether such rights can be claimed, but under what circumstances and in what manner they can be asserted. The effects of the federal government's regulatory property rights under the acts are considered. (Baker-IVI)
W85-06531

GARRISON DIVERSION: CONSTRAINTS ON CONFLICT RESOLUTION,
Indiana Univ. at Bloomington. Dept. of Political Science.
L. K. Caldwell.
Natural Resources Journal, Vol. 24, No. 4, p 839-863, October, 1984. 1 Fig, 33 Ref.

Descriptors: *Garrison Diversion, *Legal aspects, *Manitoba, *North Dakota, *Missouri River, Water distribution, Water management, International law, Social aspects, Economic aspects, Environmental effects.

For two decades diversion of Missouri River water from the Garrison Dam to east-central North Dakota has generated controversies at local, state, national, and international levels. The major controversy has been international involving the federal governments of Canada and the United States, and the governments of the Province of Manitoba and the state of North Dakota. A discussion is offered which focuses on the need for better institutional arrangements to clarify issues, forecast consequences, and identify alternative courses of action in transboundary environmental disputes. Specific topics considered include the ramifying tendencies of large public works; issues in controversy; the propriety of public action when conflict exists among the people affected; the equity of allocating economic, social, and ecological burdens among the people affected; the adequacy of criteria to evaluate the technical, economic, social, and ecological impact of the Garrison Project; the obligations of the United States under the Boundary Waters Treaty; the ethics and politics of international environmental relationships. (Baker-IVI)
W85-06532

SURFACE RIGHTS IN ARTIFICIAL WATERCOURSES,
Colorado Univ. at Boulder. School of Law.
J. N. Corbridge, Jr.
Natural Resources Journal, Vol. 24, No. 4, p 887-928, October, 1984. 258 Ref.

Descriptors: *Water rights, *Legal aspects, *Artificial watercourses, Dam construction, Water use, Water management.

The solution of problems arising out of the creating of artificial watercourses requires an analysis of the rules governing both public and private rights in artificial waters. These rules do not lend themselves perfectly to the solution of the distinct problems presented by artificial water, but because courts have often likened the law of artificial waters to that of natural waters, analysis of artificial water problems requires some understanding of the legal principles pertaining to natural waters. The application of these principles to problems dealing with rights in natural waters is examined. A number of situations involving artificial waters are then analyzed, with specific reference to the existing law and, in some cases, suggesting reform. Nonconsumptive surface uses, both by the public and by adjacent landowners, is the focus of the discussion. The rules applicable to surface rights in natural watercourses are a complex product of common law and statutory development, and vary widely between one jurisdiction and another. The phrase artificial watercourse has been employed to describe a wide variety of factual situations. The courts have found the rules associated with natural watercourses helpful in allocating surface rights in some artificial watercourse situations, but not in others. Reliance on a complex network of common law riparian rules is arguably not an effective method of allocating surface rights to either natural or artificial waterbodies. (Baker-IVI)
W85-06533

POLLUTION CONTROL BY EFFLUENT CHARGES: IT WORKS IN THE FEDERAL REPUBLIC OF GERMANY, WHY NOT IN THE U.S.,
Washington Univ., Seattle. Dept. of Economics.
For primary bibliographic entry see Field 5G.
W85-06534

CONTINUING SAGA OF PYRAMID LAKE: NEVADA V. UNITED STATES,
W. C. Scott.
Natural Resources Journal, Vol. 24, No. 4, p. 1067-1082, October, 1984. 110 Ref.

Descriptors: *Pyramid Lake, *Nevada, *Federal jurisdiction, *Water rights, *Indian reservations, Orr Ditch, Truckee River, Water use, Irrigation water, Litigation, Negotiation.

In 1859 the Secretary of the Interior set aside 322,000 acres in and around Pyramid Lake as a reservation for the Paiute Indians. Fifteen years later the official Pyramid Lake Reservation was established. Shortly thereafter a policy of encouraging the development of arid western land was begun. This led to a conflict and for almost six years the government and various defendants gathered and exchanged information about water right claims in the Truckee River, which empties into Pyramid Lake. Work was started on the Orr Ditch litigation. When a decision was reached, the report awarded the Reservation an 1859 priority date in the Truckee for 58.7 cu ft/sec and 12,412 acre ft of water annually to irrigate 3,130 acres of delta land. The Project was awarded a 1902 priority date for 1,500 cu ft/sec to irrigate to the extent possible 232,800 acres of land. In 1926 the district court issues a temporary restraining order declaring the water rights as proposed in the report. A prolonged drought stimulated interest in concluding the Orr Ditch litigation and led to the start of settlement negotiation in 1934. The project was represented by the Truckee-Carson Irrigation District (TCID). The decision allowed the diversion of a substantial amount of Truckee River water into the Carson River Basin, practically destroying Pyramid Lake and its fishery. As a consequence, the United States in 1973 filed suit in the Federal District court on behalf of the reservation seeking additional rights to the Truckee River. The Court ruled that the Orr Ditch decree barred the Pyramid Lake Tribe's claims against TCID. Since the Tribes are now encouraged to negotiate and settle, rather than litigate, the extent of their water rights, the Court's decision raises some serious questions. The Tribes must now consider whether they will ever be able to raise a claim for additional water rights after having entered into a settlement agreement. More importantly, the Tribes will have to decide whether it is wise to pursue their current strategy of settlement if they cannot depend on the government to provide adequate representation of their interests. (Baker-IVI)
W85-06537

EVALUATION OF PUBLIC NOTIFICATION REQUIREMENTS IN CALIFORNIA,
California Univ., Berkeley. School of Public Health.
W. H. Bruvold, L. Wardlaw, and J. M. Gaston.
Journal of American Water Works Association, Vol. 77, No. 3, p 40-43, March, 1985. 5 Tab, 6 Ref.

Descriptors: *California, *Drinking water, *Water quality control, *Notification, *Public opinion, Attitudes, Public awareness, Maximum contaminant levels, Water pollution.

The public notification requrements of violations of maximum contaminant levels (MCLs) in drinking water were evaluated through a scientific sampling of residents of 15 California communities. Each community had recently notified consumers of an MCL violation. The sampling assessed public awareness of the notification, the effects the media used had on awareness and knowledge of the problem and recommended solutions to the problem, and the attitude of the respondents regarding the notification requirement and its effectiveness. This assessment of the value of the requirement points to ways in which the stated objectives could be reached more successfully. It is proposed that future objectives of notification efforts should be to make 90% of the consumers aware of the notification and 67% knowledgeable regarding the contaminants of concern and the long term solutions. The present research indicates that public notification programs can attain these objectives if they distribute written messages to the entire population served, describe the problem in nontechncal language, describe the nature of the contaminant of concern and its related health effects, and describe the underlying problem facing the water system and the nature of the long term solution required. (Baker-IVI)
W85-06583

EXTRA EFFORT WINS WATER QUALITY PAYOFFS,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5D.
W85-06817

NEW TACTIC AGAINST HAZARDOUS WASTE,
New Jersey Dept. of Environmental Protection, Trenton.
R. E. Hughey, and A. J. McMahon.
EPA Journal, Vol. 11, No. 3, p 16-17, April, 1985. 2 Fig.

Descriptors: *Legislation, *New Jersey, *Water pollution control, *Hazardous wastes, Fines, Regulations, Legal aspects.

The purpose of New Jersey's Environmental Cleanup Responsibility Act (ECRA) is to determine the environmental acceptability of properties, establish responsibility for remedial actions at contaminated sites, and assure potential buyers that the property they are purchasing is free of significant contamination. The unique driving element of ECRA is the penalty section. First, fines up to $25,000 per day per violation may be collected, and anyone who knowingly gives false information may be held personally liable for the penalty. Second, the Department is authorized to void any sale where the selling party fails to submit a negative declaration or cleanup plan. Finally, the purchaser may void a sale for any violation of ECRA

and may recover any damages. Examples of the use of the law in actual cases are presented. (Baker-IVI)
W85-06818

WATER LAW,
Cook Coll., New Brunswick, NJ.
W. Goldfarb.
Butterworth, Boston. 1984. 223 p.

Descriptors: *Water law, *Legal aspects, *Water rights, Appropriation, Surface water, Groundwater, Diversion, Water transfer, Interbasin transfers, Drainage, Channel improvement, Water resources development, Water supply development, Federal jurisdiction, Bureau of Reclamation, Army Corps of Engineers, Soil Conservation Service, Tennessee Valley Authority, Licenses, Land use, Public rights, Public access, Instream flow, Recreation, Floodplains, Wetlands, Effluent limitations, Construction, Leachates, Oil spills, Acid precipitation, Water conservation, Agriculture, Municipal water, Judicial decisions, Clean up, Clean Water Act, Water pollution, Industrial wastes, Weather modification, Nonpoint source pollution, Safe Drinking Water Act.

This book has four sections. Part I, the law of water diversion and distribution, includes the legal classification of water, water diversion doctrines (riparian system, Eastern permit systems, and prior appropiation), groundwater doctrines, federal and federal-state diverison law, interbasin and interstate transfers, drainage law, and water distribution organizations (irrigation and municipal water supply). Part II, water resources development and protection, discusses the federal government's role (Bureau of Reclamation, Corps of Engineers, Soil Conservation Service, Tennessee Valley Authority, Nuclear Regulatory Commission, and Federal Energy Regulatory Commission) and limitations on the governments's involvement. Part III, nontransformational uses, discusses the use of rivers and streams, use of lakes, access to beaches and marine facilities, recreation, programs, floodplains protection, wetlands protection, weather modification, acid precipitation, and conservation and reuse of water. Part IV, water treatment and land use, includes the Clean Water Act, ocean dumping, groundwater discharges, oil and hazardous substances cleanup, drinking water protection, and common law remedies.
W85-06933

GUIDE TO GROUND-WATER STANDARDS OF THE UNITED STATES.
Ecological Analysts, Inc., Sparks, MD.
API Publication 4366, American Petroleum Institute, Washington, DC. July 1983. 80 p.

Descriptors: *Water law, *Legal aspects, *Standards, *Groundwater, *Water quality control, *Regulations, Clean Water Act, Safe Drinking Water Act, National Interim Drinking Water Regulations, Sole Source Aquifer, Injection wells, Toxic Substance Control Act, Federal Insecticide Fungicide Rodenticide Act, Resource Conservation and Recovery Act, Comprehensive Environmental Response Compensation and Liability Act, Monitoring, Classification, Drinking water, Permits, Wells, Aquifers.

Information on federal and state regulations concerning the use and protection of groundwater is organized. An overview of technical and regulatory concepts and terminology is followed by a summary of federal programs, which provide the basis for state regulations. For each state the following information is supplied: groundwater classification, groundwater quality standards, drinking water standards, groundwater appropriation, controlled use or special permit areas, well construction standards, underground injection control, groundwater monitoring at waste management facilities, sole source aquifers, references, state contacts, and tables of numerical and narrative standards.
W85-06940

COMPLYING WITH NPDES PERMIT LIMITS: WHEN IS A VIOLATION A VIOLATION,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. E. Herricks, D. J. Schaeffer, and J. C. Kapsner.
Journal of the Water Pollution Control Federation, Vol. 57, No. 2, p 109-115, February, 1985. 43 Ref.

Descriptors: *Regulations, *Permits, *Enforcement, *Water pollution control, Water quality control, Monitoring, Liability, Statistical analysis, Sampling, Detection limits, Legal aspects.

National Pollution Discharge Elimination System (NPDES) compliance audits are based on effluent monitoring by EPA and state agencies and data provided through the self-monitoring of NPDES permit holders. Compliance with water quality standards is assessed through ambient water quality monitoring by state and federal agencies using samlping networks or special studies. Both monitoring programs have been the basis of critical Government Accounting Office (GAO) reports. Regulatory authorities must recognize the nature of both data they collect and the data reported to them. In addition, these authorities, and the state legislatures must recognize the consequences of statistical reality. The failure of the law as implemented to incorporate the statistical properties of natural systems, and the concomitant failure to recognize that variability is intrinsic to measurement deprives present environmental statutes of the rational basis needed to support strict liability. Until both natural systems and the harm done to them can be accurately measured, it may be inappropriate to impose penalties without regard to some form of fault. The recent GAO reports do not help find an answer because they do not recognize the problem. Further, the courts have not yet faced the question in the context of either an enforcement action or a challenge to agency standard setting. However, it is only a matter of time before the vulnerability of EPA on this issue is exposed. (Baker-IVI)
W85-07038

LOSSES FROM EFFLUENT TAXES AND QUOTAS UNDER UNCERTAINTY,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5G.
W85-07089

6F. Nonstructural Alternatives

GROUNDWATER MANAGEMENT PLAN FOR STUDY AREA 1, COASTAL PLAIN FORMATIONS,
Camp, Dresser and McKee, Inc., Boston, MA.
H. O. Banks.
Final Report, March 1982. 376 p, 57 Exhibits, 48 Ref.

Descriptors: *Groundwater management, *Management planning, *Coastal plains, *Aquifers, *Interstate rivers, *Aquifer characteristics, *Piezometers, Administration, Rivers, Surface-groundwater relations, Catchment areas, Interstate commissions, Delaware River.

The management was studied the groundwater resources of the coastal plain portion of the Delaware River Basin. Two primary tools were developed for regional analyses and evaluations of the response of the aquifer system: a coarse Mass Balance Model of three aquifer groups, and a more detailed finite element model of the Potomac-Raritan-Magothy. Among the management strategies examined were redistribution, surface water substitution, and a combined redistribution/substitution method. The combined method represents the most attractive case examined. Under this strategy, piezometric levels in the Camden cone would rise to roughly twenty feet below sea level and the rate of movement of the deep salt front would be slowed to less than one-half its current rate. A net flow from the aquifer to the river would be maintained downstream of Camden, thereby minimizing the threat of salt of organic contamination. Piezometric levels near Wilmington would also rise to roughly twenty feet below sea level. A critical component of the proposed groundwater management plan is the establishment of nine management zones based primarily on hydrogeological considerations including outcrop areas, variations in estuary water quality, and channel bed permeabilities. The plan describes the zone-specific recommendations and calls for relocated future groundwater withdrawals away from stressed areas and substituting surface water where possible. (Hawkins-Omniplan)
W85-06334

FLOOD DAMAGE MITIGATION: A REVIEW OF STRUCTURAL AND NONSTRUCTURAL MEASURES AND ALTERNATIVE DECISION FRAMEWORKS,
Wollongong Univ. (Australia). Dept. of Economics.
For primary bibliographic entry see Field 6B.
W85-06495

6G. Ecologic Impact Of Water Development

IMPACT OF SMALL-SCALE DAMS ON FISHES OF THE WILLAMETTE RIVER, OREGON AND AN EVALUATION OF FISH HABITAT MODELS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
H. W. Li, C. B. Schreck, R. A. Tubb, K. Rodnick, and M. Alhgren.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157782/AS, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute, Oregon State University, Publication WRRI-91, Nov. 1983. 81 p, 13 Fig, 17 Tab, 59 Ref, Project No. OWRT B-077-ORE (1), Contract/Grant No. 14-34-0001-1259.

Descriptors: *Dams, *Fish, *Anadromous fish, Habitats, *Aquatic habitats, Habitat models, *Fish habitat models, Hydroelectric power, Willamette River, *Oregon.

Two aspects of the potential effects of small-scale hydroelectric dams on fish communities in the Willamette River were examined. The first study was to determine whether or not models of habitat assessment based solely upon physiological tolerances would be suitably accurate for prediction of impact. It was found that ecological processes such as interspecific competition greatly limit the accuracy of habitat models based solely on physical variables. Also, distributional patterns of fishes differed among streams, presumbly due to different limiting factors which shift fish behavior. A multivariate approach was developed to define habitat selection, by denoting habitat availability and habitat occupation based on microhabitat characteristics. The second study was to determine physical and ichthyofaunal characteristics for unimpounded streams and for streams impounded by various types of small-scale dams. Also, the types of impacts of small-scale dams were identified and the predictive capacity of habitat suitability models was evaluated. In general, larger dams caused more negative impact due to diminution of flow, a greater amount of siltation, and a larger impounded area. Small dams in areas subjected to low summer flows may be beneficial, offering pool refuge for cutthroat trout. Predators of juvenile anadromous salmoid fishes are attracted to tailraces below dams and may cause a bottleneck to seaward migration.
W85-06321

CHANNEL CHANGE WORKSHOP PROBLEM NUMBER 3, ELK RIVER, KANSAS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
E. H. Grissinger.
Report FWS/OBS-81-148, September 1981. Reprint from: Proceedings: Workshop on Downstream River Channel Changes Resulting from Diversions or Reservoir Construction. p 209-221, 3 Figs, 11 Refs.

Descriptors: *Drainage systems, *Channel flow, Watersheds, Elk River, Kansas, Streams, Paleocli-

matology, Erosion, *Channel morphology, *Channel erosion, Sedimentation, Mississippi, Iowa.

The Elk River, Kansas is typical of many streams in the Mississippi drainage system. It has a deep channel incised into late to postglacial valley-fill deposits. At present, the distribution and properties of these valley-fill deposits are undefined and this lack of information prevents reliable prediction of channel adjustments resulting from significant watershed changes. Studies in northern Mississippi and western Iowa, which have established the significance of comparable valley-fill deposits, have been used as case examples. This case history application is based on preliminary results indicating the valley-fill units were deposited in response to paleoclimatic controls. Alternate scenarios are presented based upon vegetative or stratigraphic controls and upon hydraulic-induced or gravity-induced bank failure.
W85-06354

FUNDAMENTALS CONCERNING ECOLOGICAL-AND-ECONOMICAL ESTIMATION OF THE WATER AND WATER-ADJACENT ECOSYSTEMS FUNCTIONING CHANGES UNDER THE INFLUENCE OF ANTHROPOGENIC FACTORS (OSNOVNYE POLOZHENIYA EKOLOGO-EKONOMICHESKOI OTSENKI IZEMENII FUNKTSIONIROVANIYA VODNYKHI OKOLOVODNYKH EKOSISTEM POD VOZDEISTVIEM ANTROPOGENNYKH FAKTOROV),
O. N. Taran, and V. M. Tregobchuk.
Gidrobiologicheski Zhurnal, Vol. 21, No. 1, p 55-61, 1985. 7 Ref.

Descriptors: *Environmental effects, *Economic aspects, *Hydroelectric plants, *Water management, Ecological effects, Ecosystems, Construction.

The effects of anthropogenic factor (hydroelectric and water management) on water and near-water ecosystems can be positive or negative, depending on which of the possible construction and usage options is chosen. An economic-ecological evaluation of the effects of hydroelectric development and water management on aquatic ecosystems is needed that would reduce negative effects from projects as much as possible. Methodological recommendations are made concerning ecological and economic estimation of the water and water-adjacent ecosystem changes resulting from the water management and powerplant construction. (Moore-IVI)
W85-06378

EFFECTS OF WINTER WARM RESERVOIR RELEASE ON BENTHIC STREAM INVERTEBRATES,
Bergen Univ. (Norway). Zoological Museum.
G. G. Raddum.
Hydrobiologia, Vol. 122, No. 2, p 105-111, 1985. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Environmental effects, *Regulated flow, *Invertebrates, *Reservoir releases, *Thermal pollution, Holmevassana River, Tverrana River, Naustdalsana River, Norway, Rivers, Water resources development, Reservoirs, Aquatic insects.

Possible changes in life history, drifting patterns and differences in abundance of insect larvae caused by river regulation are presented. Benthos were investigated during the summer seasons of 1971 and 1972 in three small mountain rivers, Holmevassana and Tverrana (regulated) and Naustdalsana (natural) 950-1050 m a.s.l. in Norway. Holmevassana became free of ice and snow in the winter due to the increased flow and higher temperature of the released water. In the other two rivers the flow was too small to break up the ice and snow cover. Similar groups and species of fauna were recorded in each water body, but differences in abundances were noted. The most conspicuous difference was the drifting pattern of chironomid larvae, which reflected changes in winter growth. In Holmevassana River the drift of larvae was highest in the daytime during July and August. In Tverrana River, larval drift was highest at night in July, but changed to daytime in August and September. The earlier development of insects in Holmevassana, caused by the winter warm conditions can put adult insects into terrestrial environments, to which they are not adapted. In such cases the imagos can be immobilized to a great extent on snow-covered fields before reproduction. (Baker-IVI)
W85-06385

DECLINE OF STRIPED BASS IN THE SACRAMENTO-SAN JOAQUIN ESTUARY, CALIFORNIA,
California State Dept. of Fish and Game, Stockton.
For primary bibliographic entry see Field 5C.
W85-06403

STRIPED BASS, TEMPERATURE, AND DISSOLVED OXYGEN: A SPECULATIVE HYPOTHESIS FOR ENVIRONMENTAL RISK,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W85-06404

SUMMER MORTALITY OF STRIPED BASS IN RESERVOIRS OF THE UNITED STATES,
Oklahoma Univ., Kingston. Biological Station.
W. J. Matthews.
Transactions of the American Fisheries Society, Vol. 114, No. 1, p 62-66, January, 1985. 1 Fig, 2 Tab, 4 Ref. FWS contract 14-16-0009-82-018.

Descriptors: *Striped bass, *Mortality, *Reservoirs, Seasonal variation, Limnology, Multivariate analysis, Reservoir fisheries.

A survey of 80 reservoirs in the United States with striped bass Morone saxatilis populations indicated some summer mortality of the species in 27 (34%) of the impoundments. Most of the reported mortality was of medium sized to large adults (> 5 kg). More mortality was reported in July-September than in other months. Reservoirs for which summer striped bass mortality was reported had significantly greater mean surface area, volume, maximum depth, and depth of water release than those without reports of striped bass mortality. However, the presence or absence of reported striped bass mortality bore no discernible relationship to reservoir morphometric or limnological features when 20 such characteristics were examined by multivariate analysis. The results suggest overall that summer mortality of striped bass is widespread geographically in reservoirs of the United States, but its occurrence is highly variable and by no means universal. (Author's abstract)
W85-06405

SUMMER SELECTION OF THERMAL REFUGES BY STRIPED BASS IN ALABAMA RESERVOIRS AND TAILWATERS,
Alabama Dept. of Conservation and Natural Resources, Montgomery. Game and Fish Div.
For primary bibliographic entry see Field 2H.
W85-06407

EFFECT OF REGULATION OF THE NILE RIVER DISCHARGE ON THE OCEANOGRAPHIC CONDITIONS AND PRODUCTIVITY OF THE SOUTHEASTERN PART OF THE MEDITERRANEAN SEA, (UTJECAJ REGULACIJE DOTOKA RIJEKE NIL NA OCEANOGRAFSKA SVOJSTVA I PRODUKCIJU JUGOISTOCNOG DIJELA SREDOZEMNOG MORA),
Institute of Oceanography and Fisheries, Alexandria (Egypt).
W. F. Wadie.
Acta Adriatica, Vol. 25, No. 1/2, p 29-43, 1984. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Nile River, *Mediterranean Sea, *Aquatic productivity, Plankton, Seasonal variation, Dams, Environmental effects, Dam construction, Fish migration,.

Before the damming of the Nile River, the southeastern part of the Mediterranean Sea was one of the most productive areas in the Mediterranean Sea (Gorgy and Shaheen 1964; El-Zarka and Koura, 1965; Gorgy, 1966; Halim et al., 1967). The Nile discharge was the main reason for the high biological productivity of the shelf waters of the southeastern part of the Mediterranean Sea. The life cycle of sea organisms in this area depends mainly on the river discharge, particularly on the seasonal dynamics of plankton and pelagic fish migration. Therefore, the high decrease in the river discharge after 1965 affects greatly the physical, chemical and biological conditions in the southeastern part of the Mediterranean Sea. (Author's abstract)
W85-06423

EVALUATION OF TILAPIA SPP. IN LAKE MANZALAH AS POND FISHES, (PROCJENA TILAPIA SPP. U JEZERU MANZALAH KAO RIBNJACARSKIH VRSTA),
Institute of Oceanography and Fisheries, Alexandria (Egypt).
N. F. Bishara.
Acta Adriatica, Vol. 25, No. 1/2, p 87-99, 1984. 8 Tab, 10 Ref.

Descriptors: *Lake Manzalah, *Egypt, *Land reclamation, *Environmental effects, Fisheries, Lakes, Fish farming.

Lake Manzalah, the largest brackish delta lake of Egypt, is subject to large land reclamation projects which have diminished its area. There is now an intention to convert the periphery of this lake, which extends for about 300 km, into fish farms to compensate for the decrease in fish production. This study was made on Tilapia aurea and T. nilotica in winter 1980 and spring 1981, to evaluate their potential as pond fishes in the proposed fish farms. Age analysis was carried out to show difference in growth for the fish in two seasons and for both sexes. Sample standard deviation and the population standard deviation were calculated for length and weight in two species. Length-weight equations and the differential rate of increase in fish weight per unit length were calculated, together with the survival rate of fish. From this information, recommendations for the successful culture of T. aurea and T. nilotica in fish farms constructed on the periphery of Lake Manzalah are given. (Author's abstract)
W85-06424

FORMATION OF ICHTHYOFAUNA IN THE SASYK RESERVOIR UNDER CONDITIONS OF FRESHENING (FORMIROVANIE IKHTIOFAUNY SASYKSKOGO VODOKHRANILISHCHA V VSLOVIYAKH OPRESNENIYA),
V. A. Tkachenko, and A. N. Voloshkevich.
Gidrobiologischeski Zhurnal, Vol. 20, No. 2, p 47-50, 1984. 1 Tab, 9 Ref.

Descriptors: *Fish populations, *Species composition, *Sasyksky Reservoir, Reservoirs, Lagoons, Water resources development, Environmental effects.

Formation of a freshwater reservoir in the place of the marine lagoon resulted in radical reconstruction of ichthyofauna. The Sasyksky reservoir studied in 1981 to 1982 contained 42 fish species, mainly freshwater ones. Such food fishes as roach, bleak, carp-bream, sichel, goldfish, common carp, pike-perch and common perch are predominant among fish fry and older age groups. Due to the formation of valuable food fish schools commercial fishing is, at present, strictly forbidden. Fish species of low value whose reserves are under utilized may be caught. (Author's abstract)
W85-06468

SAVE THE EVERGLADES,
S. Douglas.
Oceans, Vol. 18, No. 2, p 3-9, March, 1985. 6 Fig.

Descriptors: *Everglades, *Wildlife habitats, *Florida, *Wilderness areas, Wildlife management, Water resources development, Environmental effects, Wetlands, Roads, Canals.

Efforts are underway in Florida to stop the damage occurring to the Everglades. The Everglades proper, that 100 miles of saw grass marsh stretching south from Lake Okeechobee, is only the downstream end of the 9,000 square mile Kissimmee Basin, Lake Okeechobee/Everglades ecosystem. Included in the Save the Everglades plan are commitments to reestablish the value of the Kissimmee River, involving either complete or partial elimination of canal C-38 and a restoration of the marshlands; restore a ninety-five-square mile area in Palm Beach County known as the Holey Land and Rotenberger tracts, now drained and fallow; manage the deer herd in Water Conservation Area 3 so it can better survive high water levels; remove the scar of Alligator Alley, a state road cutting across the peninsula which now acts as a barrier to sheet flow and breaks up animal habitats; restore Everglades National Park, including the support of an emergency plan for more equitable water delivery into the park; and preserve the Florida panther in the Big Cypress Preserve, Fakahatchee Strand, and Everglades National Park. (Baker-IVI)
W85-06563

CALIFORNIA APPROACH TO PLUMBING,
C. Caufield.
New Scientist, Vol. 105, No. 1444, p 24-27, 21 February, 1985. 7 Fig.

Descriptors: *Water resources development, *San Joaquin Valley, *San Francisco Bay, *California, Environmental effects, Irrigation, Groundwater pollution, Water supply development, Water demand, Water use, Salinity, Wildlife habitats, Seawater intrusion.

California has developed what has been called the most sophisticated plumbing system in the world. Half of the 35 billion cu m of water used in the state is shipped hundreds of km from the north to the south. Rivers that naturally ran from east to west have been reversed by electrical pumps. Shipping water around is the biggest single consumer of electricity in California. One result of this massive manipulation of water is an extraordinarily productive agriculture. Salinity is, however, always a problem with irrigated soils. To rescue salt soils in the San Joaquin Valley may cost twice as much as providing the irrigation water in the first place. Another problem is a serious depletion of groundwater resources. California is losing 25 billion cu m of groundwater a year. Overuse stimulated by low prices is damaging the largest inland estuarine system in the US, the Sacramento-San Joaquin Delta, once a wild marshland. In 1977 seawater had come so far up the delta that several temporary rock dams had to be built to protect water destined for the south. Another problem is caused by pollutants entering the delta. Water projects which have halved the influx of fresh water to the bay have reduced natural flushing. (Baker-IVI)
W85-06567

HIGH STAKES FOR REVIVING HYDROELECTRIC POWER,
G. Robertson.
New Scientist, Vol. 105, No. 1445, p 8, 28 February, 1985. 2 Fig.

Descriptors: *Hydroelectric plants, *Scotland, *Grudie River, *Talladale River, Water resources development, Environmental effects, Powerplants.

Scotland is switching from oil and nuclear power back to hydroelectricity. However, the plan to build the first hydroelectricity scheme in the past 20 years is having difficulty. Some conservationists see the plan as good while others view it as destroying some of Scotland's most spectacular scenery. The waters of the Grudie and Talladale rivers will be used to generate electricity in two small power stations, with a total capacity of around 10 megawatts. The rivers flow into Loch Maree, in the heart of an area newly designated by the Nature Conservancy Council as a Site of Special Scientific Interest. Officials for the Lock Ewe District Salmon Fishery Board also object saying these rivers are much more important for salmon and sea trout than had been realized. Most of the pipe work is to be placed underground and the power stations are to be well screened. The crux of the matter is whether the project makes economic sense. The need for the appointment of an expert committee of inquiry to review the development of hydroelectric generation in Scotland has been recognized. (Baker-IVI)
W85-06568

STREAM-WATERSHED RELATIONS IN THE MISSOURI OZARK PLATEAU PROVINCE,
Missouri Agricultural Experiment Station, Columbia.
M. M. Smart, J. R. Jones, and J. L. Sebaugh.
Journal of Environmental Quality, Vol. 14, No. 1, p 77-82, January/March, 1985. 3 Fig, 5 Tab, 28 Ref.

Descriptors: *Water chemistry, *Watersheds, *Streams, *Missouri, Chlorophyll a, Nutrients, Land use, Forests, Pastures, Urban areas, Water quality, Algae.

Water chemistry and algal chlorophyll values in Missouri Ozark streams were more strongly related to land-use practices on the watershed than bedrock geology or soil association. In general, concentrations of nutrients, chlorophyll, and most major ions were lowest in streams draining forests, intermediate in streams draining pastures, and highest in streams draining urban areas. In streams draining both forest and pasture areas, there was an exponential increase in the concentration of total P, total N, NO3(-)-N, Na(+), Cl(-), and suspended chlorophyll a with an increase in percent pasture area on the watershed. These relations help identify the relative importance of land use on water chemistry and algal chlorophyll values, explain differences among streams in the region and enable one to approximate the impact of forest-pasture conversion on streams not yet affected. (Author's abstract)
W85-06620

AGRICULTURE IN CHINA - A DETERIORATING SITUATION,
Leiden Rijksuniversiteit (Netherlands). Sinological Inst.
For primary bibliographic entry see Field 4C.
W85-06630

DAMNATION OF PARADISE,
L. Alexis.
Ecologist, Vol. 14, No. 5/6, p 206-215, 1984. 4 Fig, 80 Ref.

Descriptors: *Sri Lanka, *Mahaweli Scheme, *Water resources development, Dam effects, Environmental effects, Public health, Water shortages, Disease, Salinization, Deforestation, Economic aspects, Political aspects.

In the desperate search for a large-scale technological solution to Sri Lanka's increasing food and employment requirements, the government has embarked on a multi-billion dollar, five dam project that will threaten ecological stability in a large portion of the country's interior and is already causing social problems. Numerous critics have spoken out against the scheme, but the state appears unwilling to listen. In order to get a clearer picture of the tremendous effects that the Accelerated Mahaweli Project is having upon the Mahaweli Ganga's numerous, complex, ecological systems, the course of the river is traced, examining some of the impacts caused by each of the projects in the overall scheme. Specific parts of the total project examined include the Three Peneplains, the Kotmale Dam, the Polgolla Diversion, the Victoria Dam, the Randenigala Project, the Madura Oya Project, the resettlement scheme, and the H Area scheme. The following problems are expected to arise due to the overall project: increased waterborne disease, water shortages, salinization, deforestation, landslides in Kotmale Valley, high foreign debts, loss of flora and fauna, and corruption and bribing of local officials. (Baker-IVI)
W85-06631

MYTH OF THE BENIGN SUPERDAM,
E. Goldsmith, and N. Hildyard.
Ecologist, Vol. 14, No. 5-6, p 217-220, 1984. 1 Fig, 23 Ref.

Descriptors: *Environmental effects, *Water resources development, *Dam construction, Dam effects, Water quality control, Environmental impact, Ecology, Public rights, Salinization, Irrigation, Economic aspects.

Several requirements are suggested which, if followed, in constructing dams, would provide water on a sustainable basis and without incurring intolerable social and ecological costs. No dam should be built until an adequate assessment of its likely environmental effects has been undertaken and made available to the public. Water development projects should only be undertaken if they can be shown to benefit large sectors of the population. The scheme should favor labor-intensive rather than capital-intensive economic activities. Future water development schemes should permit the production of food crops for feeding the local population rather than for growing export crops. Schemes should not be built which would compromise public health and safety in ways that would be viewed as unacceptable to the people affected. Schemes should not be built if they adversely affect national parks, heritage sites, areas of scientifc and educational importance, tropical rainforests or areas inhabited by wild animals threatened with extinction. Dams should only be built where it can be guaranteed that they will not silt up within a hundred years. Dams should not be built when their associated irrigation schemes are likely to lead to the salinization of agricultural land. Emphasis on funding should be towards sustainable long-term resource enhancement rather than short-term resource exploitation. Dams should not be built if they displace indigenous peoples from their homes and destroy their cultures. If these recommendations had to be met, few, if any, dams would be built. (Baker-IVI)
W85-06632

POLITICS OF DAMMING,
E. Goldsmith, and N. Hildyard.
Ecologist, Vol. 14, No. 5/6, p 221-231, 1984. 3 Fig, 46 Ref.

Descriptors: *Water resources development, *Environmental effects, *Political aspects, Economic aspects, Dam construction, Decision making, Planning, Developing countries.

Dams and other large-scale water projects have been given the go-ahead on the basis of some cursory ecological appraisals. In some cases the appropriate studies were undertaken only after building work had begun. Examples are provided to make the point. James Bay, Canada, was approved before any ecological or economic cost-benefit studies had been undertaken. No studies were undertaken on the ecological effects of the Kindaruma and Kamburu dams on Kenya's Tana River before construction work began. The introduction of modern canal irrigation to the Helmand Valley of Afghanistan was undertaken without any consideration of the possibility that the land might become salinized. The sole environmental study of West Africa's Selingue dam on the Mali-Guinea border dealt briefly with the tourist potential of the reservoir, its possible harm to water quality in the region and seismic stability. The role of politics in decision making for dam construction is described. (Baker-IVI)
W85-06633

TRANSFORMATION OF THE OB RIVER CHANNEL DOWNSTREAM OF THE NOVOSIBIRSK HYDROELECTRIC STATION,
A. B. Veksler, and V. M. Donenberg.
Hydrotechnical Construction, Vol. 18, No. 9, p 437-443, September 1984. 3 Fig, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 46-50, September, 1984.

Descriptors: *Water resources development, *Environmental effects, *Novoskbirsk Hydroelectric Station, *Ob River, Channels, Rivers, Discharges, Excavation, Hydraulic regime, Construction.

Investigations of processes of transformation of the Ob channel in the lower pool of the Novosibirsk hydrostation convincingly show the need for timely consideration of the consequences caused by man's interference in the life of the river. The preparation of a scientifically founded forecast of channel transformation when designing hydrostations should include an assessment of the effect on the fluviomorphological process of quarry excavations, training works, and construction of intake and outlet works. Insufficient consideration of these factors and the lack of due supervision of works affecting the course of the fluviomorphological process under conditions of a river with a regulated flow can be the cause of irreversible channel transformations and changes in the hydraulic regime which can effect substantial complications for various branches of the economy. (Baker-IVI)
W85-06710

QUANTITY AND QUALITY OF SESTON IN AN IMPOUNDED AND A FREE-FLOWING RIVER IN VIRGINIA, U.S.A.,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Entomology.
For primary bibliographic entry see Field 2H.
W85-06791

EFFECTS OF FLOODING ON VEGETATION AT SALAMONIE RESERVOIR,
Miami Univ., Oxford, OH. Dept. of Botany.
P. T. Arnold, and R. E. Brown.
Proceedings of the Indiana Academy of Sciences, Vol. 93, p 153-159, 1983. 4 Fig, 15 Ref.

Descriptors: *Flooding, *Vegetation, *Salamonie Reservoir, *Indiana, Species diversity, Trees, Shrubs, Flood frequency, Water level fluctuations, Ecological effects.

Salamonie Dam was built primarily for flood control purposes on the Salamonie River in the upper Wabash Basin. The normal annual variation in water level is 25 ft. Salamonie Reservoir experienced very high water levels in two previous years. Vegetation was studied along three transects parallel to the shoreline at four sites on the north shore and one site on the south shore of the reservoir. Due to the widely varying habitats found at Salamonie Reservoir, areas with medium and low flooding frequency often had large differences in species composition between the study sites. These differences were much less pronounced and often absent in an area of high flooding frequency. At Salamonie Reservoir, the impact of high flooding frequencies appears to overshadow most of the other parameters that determine the species composition of an ecosystem. The tolerance of trees and shrubs to flooding at Salamonie is similar to studies in several other localities. Salix spp. and Populus spp., commonly referred to as 'resistant' in previous studies, experience very little mortality in the Salamonie floods. Due to their adaptations toward inundation, they have been recommended often for the protection of periodically flooded banks. There was a widespread mortality of Robinia in the highest inundation levels. Since Robinia is commonly planted at Salamonie for wildlife forage purposes, it may be appropriate to avoid planting it in frequently flooded areas. (Cutty-IVI)
W85-06847

EFFECT OF FLOODING ON SMALL MAMMAL POPULATIONS AT SALAMONIE LAKE,
Huntington Coll., IN. Dept. of Biology.
R. E. Brown, and P. T. Arnold.
Proceedings of Indiana Academy of Science, Vol. 93, p 167-172, 1983. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Flooding, *Mammals, *Animal populations, *Salmonie Lake, *Indiana, Rodents, Shrews, Environmental effects, Behavior, Dam effects.

Salamonie Dam, completed in 1966, was built primarily for flood control purposes on the Salamonie River in northeastern Indiana. At summer pool the lake covers 2860 acres, and at flood control pool, the lake would cover 9340 acres. Flooding in March of 1983 provided an opportunity to investigate and compare the movements of several species of shrews and rodents into recently flooded land. An earlier study was carried out by a snap trapping program between May 25 and July 2, 1982 at Salamonie Lake in Huntington and Wabash Counties. The study provides base-line data for any subsequent investigations which may be made in the same area. A total of 28 rodents (3 species) and 6 shrews (2 species) were caught in 1476 trapnights. Results by species and trap sites are tabulated. An examination of the data indicates that three species of rodents reinvaded the flooded areas for relatively great distances as water receded. These particular species have been known in the past to be good swimmers. (Baker-IVI)
W85-06848

AQUATIC BIRDS OF THE WHITE RIVER, UINTAH COUNTY, UTAH,
Bio-Resources, Inc., Logan. UT.
B. B. Steele, and S. B. Vander Wall.
Great Basin Naturalist, Vol. 45, No. 1, p 113-116, January, 1985. 2 Tab, 5 Ref.

Descriptors: *Environmental effects, *Waterfowl, *Population dynamics, *White River, *Utah, Dam effects, Reservoirs, Birds, Water resources development.

Abundance, seasonal use, and species composition of waterfowl and other aquatic birds are described along a 32.8 km stretch of the White River, Uintah County, Utah at the site of the proposed White River Dam. Waterfowl were most abundant during spring migration in April. During winter, late summer and fall, even waterfowl abundance was low and relatively constant at 0.31 to 0.36 birds/river km. Only the Canada Goose breeds in the study area. Several other species of aquatic birds were recorded. Great Blue Herons were fairly common transients in spring and summer, but do not breed in this area. Aquatic habitat along the White River is apparently important to the waterfowl primarily during spring migration, although the Canada Goose nests in moderate numbers. The Spotted Sandpiper also breeds there. In terms of total numbers of waterfowl, the White River is not as important as reservoirs and other impoundments near the Green River. If the White River Dam is built, changes in the abundance and composition of the aquatic bird fauna of the White River will depend on three factors: colonization of plants on the margin and bottom of the reservoir, decreased turbidity of the water, and changes in populations of aquatic organism including fish, insects, plankton, that are components of the aquatic food web. Decreased turbidity, and changes in prey populations as well as the presence of open water will be responsible for the major changes in the aquatic avifauna. (Baker-IVI)
W85-06870

HANDBOOK OF ENVIRONMENTAL QUALITY MEASUREMENT AND ASSESSMENT: METHODS AND TECHNiQUES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. E. Henderson.
Instruction Report E-82-2, May 1982. Final Report. 350 p, 3 Append: Append A - 7 p; Append B - 280 p, 18 Fig, 25 Tab; Append C - 58 p, 696 Ref.

Descriptors: *Environmental effects, *Planning, Mathematical studies, Checklists, Maps, Networks, Model studies, Evaluation, Economic aspects, Water resources, Water management, Water analysis, Aquatic habitats, Habitats, Wildlife.

Environmental analysis techniques for planning and evaluation are presented. Generic types of environmental analysis methods include matrix-based methods, checklists, map/overlay methods, network analysis, comprehensive assessment and evaluation, and modeling. Technique profiles are given to support planning steps. An appendix contains measurement and evaluation techniques for use in Environmental Quality Evaluation Procedures with (a) technique profiles that describe methods, techniques, and procedures for characterizing ecological, cultural and aesthetic factors and (b) Profile Characteristics Matrices.
W85-06897

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 7: MANAGEMENT OF ECOLOGICAL DATA IN LARGE RIVER ECOSYSTEMS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. P. Farrell, A. D. Magoun, K. Daniels, C. H. Pennington, and R. H. Strand.
Miscellaneous paper E-80-1, February 1982. Report 7 of a Series. 35 p, 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Environmental effects, *Aquatic habitats, *Data processing, *Computer programs, Mississippi River, Statistical analysis, Graphic analysis, Automation, Data storage and retrieval, Data collections.

A graphical display system was developed to expedite the research data management system for a large study on aquatic habitats on the Lower Mississippi River. PROC VIVIPLOT is a Statistical Analysis System procedure which produces copy-ready figures. From this, a data file is generated to drive several other plots. To minimize error propagation in coding variables, nonsense codes (alpha-numeric codes with no imbedded information) were used in place of smart codes.
W85-06899

AQUATIC BIOTA OF BANK STABILIZATION STRUCTURE ON THE MISSOURI RIVER, NORTH DAKOTA,
National Fishery Research Lab., La Crosse, WI.
R. M. Burress, D. A. Krieger, and C. H. Pennington.
Technical Report E-82-6, May 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 102 p, 1 Fig, 35 Tab, 20 Ref, Append, Cooperative Agreement No. 14-16-0009-78-946.

Descriptors: *Rivers, *Bank stabilization, *Environmental effects, *Dikes, *Aquatic animals, *Aquatic habitats, *Invertebrates, *Fish, Habitats, Benthos, Missouri River, North Dakota, Oligochaetes, Dipterans, Caddisflies, Insects, Algae, Erosion control, Stream banks.

Biological and physical samples were collected from nine habitats on the Missouri River near Washburn, North Dakota. The habitats were six bank stabilization structures (earth core dike, hard point dikes, revetments, wing dikes, and L-head dikes) and three natural locations. Benthic samples included 11 families, numerically dominated by oligochaetes (63%) and dipterans (34%). Mud or mud-fine sand substrates yieled 93% of the organisms collected. Densities of benthic organisms were greatest at two locations that included extensive areas of backwater (L-head dike and wing dike) and least at a revetted location where the substrate was largely fine sand. Rock fauna samples included 22 families, 60% dipterans, 33% trichopterans, and 7% oligochates. The average number of dipterans, trichopterans, and ephemeropterans tended to increase with current velocity to 70 cm/sec, but oligochaetes were most numerous at current speeds of 11-30 cm/sec. Maximum density of rock fauna occurred at the stone-face earth core dike. Densities of rock fauna were highest where algal growth on the rocks was heaviest and current velocity greatest; lowest where algal growth was sparse and current velocity was low. Dike fields had the most diverse fish community. Among the 26 species of fish collected, five species comprised nearly 2/3 of the catch: carp (18.3%), white bass, (15.6%), white sucker (13.7%), yellow perch (10.2%), and river carpsucker (7.8%).
W85-06902

DUCK BREEDING ECOLOGY AND HARVEST CHARACTERISTICS ON GRAND RIVER MARSH WILDLIFE AREA,

Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 2H.
W85-06903

STUDY OF CUTOFF BENDWAYS ON THE TOMBIGBEE RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. H. Pennington, J. A. Baker, F. G. Howell, and C. L. Bond.
Technical Report E-81-14, November 1981. Final Report. 139 p, 43 Tab, 13 Fig, 62 Ref.

Descriptors: *Environmental effects, *Channel improvements, *Aquatic life, *Meanders, *Rivers, Oxbow lakes, Tombigee River, Tennessee-Tombigbee Waterway, Waterways, Canals, Water quality Sediments, Phytoplankton, Algae, Aquatic plants, Water willow, Macrophytes, Mollusks, Invertebrates, Fish, Aquatic animals, Bendways.

Biological and physical data were collected in four bendways at various stages of being cut from the main navigation channel during construction of the Tennessee-Tombigbee Waterway. The substrate of the study area showed changes from a sand-gravel-fines mixture toward sand-fines. Areas within some bendways were accumulating sediment, particularly in the upper areas. Few significant changes in water quality were measured. Phytoplankton composition and chlorophyll concentrations varied little among the bendways. Phytoplankton were more numerous in the bendways than in the river itself. Aquatic macrophytes were scarce and scattered; water willow was most often encountered. The macroinvertebrate community was consistent among the bendways. Although 60 families were found, 9 accounted for over 90% of the benthos. Eighteen species of Unionid mollusks (including the rare Pleurobema) and the Asian clam were collected. In the two bendways closed during the survey period the common fish were shad, sunfish, crappy, and bass. The bendways with more riverine habitats contained minnows, catfish, and sucker. The cutoff bendways were expected to provide fish and wildlife habitats not found along the main channel.
W85-06928

EFFECT OF PEAT MINING ON FISH AND OTHER AQUATIC ORGANISMS IN THE UPPER MIDWEST.
Camp, Dresser and McKee, Inc., Milwaukee, WI. Environmental Sciences Div.
For primary bibliographic entry see Field 4C.
W85-06936

BIOLOGICAL AND ECONOMIC IMPACT OF STREAM ALTERATION IN THE VIRGINIA PIEDMONT,
Virginia Cooperative Wildlife Research Unit, Blacksburg.
J. B. Whelan, O. Maughan, L. A. Shabman, and M. Mauney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-128025. FWS/OBS-81/33, July 1982. Fish and Wildlife Service, Kearneysville, WV. Eastern Energy and Land Use Team. 47 p, 2 Fig, 17 Tab, 25 Ref, 1 Append. Contract/Grant No. 14-16-0008-1146.

Descriptors: *Channeling, *Ecological effects, *Vegetation, Cost-benefit analysis, *Wildlife, *Streams, *Land use, *Agricultural watersheds, *Wildlife habitats, Stream stabilization, Environmental effects, Benthos, Birds, Fish, Cropland, Watersheds, Species diversity.

A 31 month study was made of the effects of channelization on the aquatic/riparian wildlife resources and agricultural land-use patterns of several Peidmont streams. Recently channelized streams lacked overstory cover but had an abundant understory cover. Unchannelized streams had a larger diversity of plants plus a larger percentage of trees over 46 m tall. No major differences in water quality parameters were noted between channelized and control streams. Channelized streams had greater deposits of sand. Evenness diversity for fish and benthic communities was lower in channelized streams. Channelized streams had increased populations of Chironominae tolerant of unstable sand substrates. The shallow surface discharge impoundments associated with channelized streams appeared to have highly localized impact on the downstream benthic macroinvertebrate and fish communities. During the bird breeding season, bird species richness and diversity increased with age since channelization of the stream. No significant differences were found among study sites for either total number of small mammals or their species diversity indices. Recommendations for stream channeling are given that minimize environmental disturbances. The Roanoke Creek Watershed Work plan projected a favorable cost-benefit ratio but failed to encourage large-scale cropping of bottomland areas.
W85-06956

ENVIRONMENTAL EFFECTS OF TENNESSEE-TOMBIGBEE PROJECT CUTOFF BENDWAYS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. H. Pennington, and J. A. Baker.
Miscellaneous Paper E-82-4, U.S. Army Environmental and Water Quality Operational Studies, August 1982. Final Report. 24 p, 4 Fig, 56 Ref.

Descriptors: *Bendways, *Fish populations, *Macroinvertebrates, *Phytoplankton, *Bottom sediments, *Aquatic habitats, *Aquatic plants, *Baseline studies, Bass, Macrophytes, Fathead minnows, Sucker, Crappie, Sunfish, Mollusks, Species composition, Fluvial sediments, Impoundments, Navigable rivers, Chlorophyll.

Biological and physical data were collected from four bendways within the river portion of the Tennessee-Tombigbee Waterway before the bendways were severed from the main navigational channel. Sediment analysis and bottom profiles showed that the substrate composition of some of the bendways is changing, in general from sand-gravel-fines mixtures to sand-fines mixtures. Few significant differences were found in water quality, chlorophyll concentrations or phytoplankton composition among bendways. Aquatic macrophytes were scattered and uncommon in the four bendways. Water-willow (Justica sp.) was most commonly encountered. A consistent macroinvertebrate assemblage characterized the four bendways. Variations in importance of macrophyte families among bendways were attributed to differences in substrate type and current velocities. Based on overall ichthyofaunas, two groups of bendways were delineated that corresponded to impoundment and riverine habitats. Where impoundment conditions prevailed, shad, sunfish, crappies and bass were dominant. Riverine and lacustrine habitats were faunistically similar to riverine habitats which were dominated by minnows, catfish, and suckers.
W85-06965

BALTIMORE HARBOR AND CHANNELS DEEPENING STUDY: CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
M. A. Granat, and L. F. Gulbrandsen.
Technical Report HL-82-5, February 1982. Final Report. 174 p, 14 Fig, 18 Tab, 100 Plates.

Descriptors: *Salinity, *Environmental effects, *Channel improvement, *Channel flow, *Harbors, *Bays, *Hydraulic models, *Model studies, Tides, Channels, Navigation, Flow velocity, Models, Dredging, Salinity currents, Ecological effects, Water resources development.

A series of base tests using the verified Chesapeake Bay model were conducted for the Baltimore Harbor and approach navigation channnels at 42 ft plus a 2-ft dredging tolerance (base) and at the newly authorized 50-ft depth plus a 2-ft dredging tolerance (plan). Velocity measurements were taken at 13 selected stations while salinity and tide height measurements were collected at 68 and 10 locations, respectively. No major plan-to-base velocity differences were apparent in steady state comparisons; however, slight trends in velocity characteristics may indicate subtle variations in the hydrodynamics of the system. Appreciable salinity differences were found in the bay entrance and York Spit Channel area, generally with saltier surface values during the plan test. The James and York Rivers showed appreciable salinity intrusion decreases during the plan test. Major salinity differences were found at upper bay stations from Kent Island and above. The water column during the plan test was more stratified with fresher surface values and saltier mid-depth and bottom values compared with the base test. The largest salinity variations occured in the deepened channel of the Patapsco River. Salinity differences were found to decrease with distance from the deepened channels and at shallower water stations.
W85-06968

LARVAL FISH OF SELECTED AQUATIC HABITATS ON THE LOWER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. V. Conner, C. H. Pennington, and T. R. Bosley.
Technical Report E-83-4, February 1983. Final Report. 45 p, 10 Fig, 14 Tab, 45 Ref.

Descriptors: *Mississippi River, *Fish, *Species diversity, *Larvae, *Aquatic habitats, *Dikes, *Ecological effects, *Environmental effects, *Seasonal variation, Shad, Minnows, Silverside, Bluegills, Sucker, Carpsucker, Drum, Sunfish, Embankments.

A study was made of the effects of dike fields, revetted banks, and other habitats on fish larvae of the Lower Mississippi River (miles 505-525) from April through October 1980. The seasonal changes in the local distribution of ichthyoplankton within a dike field were also characterized. Qualitatively, a basic dichotomy was observed among the six main-stem locations sampled. During high and moderate river stages, shad dominated the collections at all main-stem locations. During periods of lower river stages, drum, carpsucker, and minnows dominated main-channel locations. The Lower Cracraft Dike Field exhibited greater larval fish diversity and abundance at open water stations than nearshore stations when river stage conditions were high to moderate. When the river stage conditions were moderate to low, the diversity of fish was also low at all major habitats. Under low water conditions the dike field ichthyoplankton showed two communities. Fish inside the middle bar were mainly shad, bluegills, and silverside. The community along the riverside of the middle bar was similar to that of the main channel.
W85-06969

MOVEMENT, TRANSPORT, AND SCOUR OF PARTICULATE ORGANIC MATTER AND AQUATIC INVERTEBRATES DOWNSTREAM FROM A PEAKING HYDROPOWER PROJECT,
Arizona Univ., Tucson.
W. Matter, P. Hudson, J. Nestler, and G. Saul.
Technical Report E-83-12, May 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 59 p, 22 Fig, 2 Tab, 54 Ref, 1 Append.

Descriptors: *Hydroelectric plants, *Invertebrates, *Water quality, *Organic matter, *Benthos, *Environmental effects, *Reservoir releases, Lake Hartwell, Savannah River, Hypolimnion, Particulate matter, Rivers, Detritus, Powerplants, Electric power production, Peaking capacity, Insects, Phytoplankton, Multipurpose reservoirs, Chlorophyll, Periphyton, Zooplankton, Aquatic plants, Macrophytes, Oligochaetes, Algae, Tailwater, Ecological effects, Benthic fauna, Benthic flora, *Aquatic habitats.

The Savannah River below Lake Hartwell, Georgia-South Carolina, receives hypolimnetic water discharged from the reservoir for peak power generation. Invertebrates and particulate organic material (POM) in the water column were collected during a 24-hr release cycle at sites 1.0, 4.5, and

12.5 km downstream from the dam. Water released during generations reached a maximum discharge of 688 cu m per sec. River discharge was less than 10 cu m per sec during nongeneration periods. Highest POM concentrations were associated with the initial downstream surge of water at the start of power generation; values were 200 to 400 times greater than those during nongeneration periods. POM concentrations rapidly decreased to less than one tenth of the initial surge levels during high flow. Much of the POM originated in the tailwater, and concentrations increased at successive downstream sites. Of the drifting invertebrates, 80 to 93 percent originated in the reservoir; the rest, primarily Oligochaeta, Diptera, and Ephemeroptera, were from the tailwater. Densities of benthic invertebrates were highest during passage of the initial release surge, whereas densities of invertebrates originating in the reservoir peaked 2 to 3 hr after the initial surge at each station, during maximum release. Densities of drifting benthic organisms decreased rapidly after the initial surge and increased with increasing distance downstream. (Author)
W85-06973

SEASONAL AND SPATIAL DISTRIBUTION OF ZOOPLANKTON IN A FLOOD CONTROL RESERVOIR AND TAILWATER,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
J. F. Novotny, and R. D. Hoyt.
Miscellaneous Paper E-83-3, October 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 19 p, 4 Fig, 23 Ref.

Descriptors: *Zooplankton, *Ecological effects, *Crustaceans, *Aquatic populations, *Population density, *Environmental effects, *Reservoir operation, Seasonal variation, Reservoirs, Predation, Rotifers, Aquatic habitats, Population dynamics, Tailwater.

Zooplankton, when available, may be an important food source for fish fry in lotic habitats. The effects of flood control reservoir operation on the downstream transport of reservoir zooplankton (both microcrustaceans and rotifers) were quantified by examining zooplankton abundances in Barren River Lake, Kentucky, and three downstream stations from August 1980 - August 1981. The decrease noted in microcrustacean and rotifer abundance downstream from the dam was attributed to predation, physical destruction, and lack of suitable habitat. During stratification (May - September), the abundance of zooplankton was greater in the tailwater than in the reservoir hypolimnion; this difference in abundance suggests that water and associated organisms were being withdrawn from upper levels in the reservoir--as well as from the hypolimnion, where most of Barren River Lake's releases come from and which normally harbors few viable zooplankters. The unstratified reservoir usually contained higher densities of zooplankton than the tailwater. The results of the study led to the conclusion that implementation of operational procedures to increase discharge of reservoir zooplankton to the tailwater may not be warranted since the complexity of factors determining reservoir zooplankton dynamics precludes their use as a reliable food source for tailwater biota. (Author's abstract)
W85-06984

EFFECTS OF PERMANENTLY RAISED WATER TABLES ON FOREST OVERSTORY VEGETATION IN THE VICINITY OF THE TENNESSEE-TOMBIGBEE WATERWAY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. V. Klimas.
Miscellaneous Paper E-82-5, U.S. Army Environmental and Water Quality Operational Studies, August 1982. Final Report. 31 p, 2 Tab, 131 Ref.

Descriptors: *Trees, *Water table rise, *Water stress, *Environmental effects, *Ecological effects, *Forests, *Oxygen depletion, *Impoundments, Water table fluctuations, Water table, Environmental impact statement, Reviews, Roots, Root zone, Oxygen deficit, Saturated soils, Saturation.

The probable effects of raising the water table on trees in the vicinity of planned impoundments along the Tennessee-Tombigbee Waterway are investigated. Raised water tables can detrimentally affect trees by causing oxygen depletion in the root zone. The ability of a tree to withstand this type of stress may be related to tree species, rooting depth, soil conditions, and the timing, duration, and frequency of encroachment of the water table into the root zone. Occasionally, trees may exhibit improved growth as a result of raised water tables, but this response may be short-lived. The forest communities likely to be most sensitive to partial root-zone saturation are those typically found on well-drained upland sites. Swamp forest communities are generally much less sensitive to increases in site moisture status and may show only decreased long-term growth and reproduction. In complex floodplain forest communities responses to raised water tables may range from near-complete mortality in areas where permanent surface saturation occurs to no effect or growth rate increases in areas where very minor subsurface water table rises occur. Except in areas where extreme stresses are anticipated, only very general impact predictions may be made.
W85-06993

DREDGE INDUCED TURBIDITY PLUME MODEL,
William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
A. Y. Kuo, C. S. Welch, and R. J. Lukens.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 111, No. 3, p 476-494, May, 1985. 7 Fig, 5 Tab, 11 Ref. US Army Corps of Engineers, Norfolk District contract DACW 65-78-C-0029.

Descriptors: *Dredging, *Turbidity, *Plumes, *Sediments, *Model studies, Channels, Environmental impact, Suspended sediments.

A model was developed to describe the turbidity plume induced by dredging a ship channel using an hydraulic dredge. The model predicts the suspended sediment concentration within the plume and the resulting sediment deposition alongside the dredged channel. The model applies to a dredging operation in a water body in which the current is primarily along the channel axis and the channel depth is large enough that no significant suspended sediment reaches water surface. Results of field measurements were compared with model results. The model describes the qualitative feature of prototype data and the calibrated model parameters agree with independent observations by other investigators. (Author's abstract)
W85-07078

INDUSTRIAL DEVELOPMENT WITHOUT ENVIRONMENTAL POLLUTION: ROLE OF ENVIRONMENTAL IMPACT ASSESSMENT (EIA),
Cremer and Warner Ltd., London (England).
E. Turner.
Asian Environment, Vol. 6, No. 4, p 27-36, 1984. 7 Ref.

Descriptors: *Environmental impact statement, *Water resources development, *Environmental effects, Management, Planning, Decision making, Water management.

The idea of the Environmental Impact Assessment (EIA) grew out of the emotionally charged era of the mid to late nineteen sixties with the chilling revelations about DDT in food chains, Minimata disease and various limitations in our living space. Some countries have published guidelines as to what is required in the preparation of an EIA. Even in countries where no formal procedures are laid down ad hoc arrangements are made for the environmental assessment of major projects. In a comprehensive EIA the breadth of topics to be covered is very wide. The actual disciplines and expertise are dictated by the nature of the project and its intended location. The study team should be professionally independent of both the developers and the controlling authorities to avoid any bias in judgement. To be useful the EIA must be an interactive process. There has to be cooperative teamwork between industrial developers, controlling authorities and the EIA Study Team. There are two main criticisms of EIAs. First, they delay projects and escalate costs. Second, they divert qualified professionals from productive work. Matters to be considered in designing an EIA are discussed, including deciding what to study, choosing the right team, a management plan, and a definition of the baseline data requirements. (Baker-IVI)
W85-07111

7. RESOURCES DATA

7A. Network Design

OPTIMAL SAMPLING STRATEGIES FOR SOURCE IDENTIFICATION IN ENVIRONMENTAL EPISODES,
Iowa Univ., Iowa City. Dept. of Geography.
For primary bibliographic entry see Field 5A.
W85-06283

DEVELOPING OBJECTIVES FOR THE GROUND WATER QUALITY MONITORING NETWORK OF THE SALINAS RIVER DRAINAGE BASIN,
Geological Survey, Menlo Park, CA.
P. Showalter.
Ground Water Monitoring Review, Vol. 5, No. 2, p 37-45, 1985. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Groundwater, *Monitoring networks, *Salinas River basin, *California, *Water quality management, Networks, Planning.

Objectives are described that were developed and applied to design a groundwater quality monitoring network for the Salinas River drainage basin in central California. Four agencies worked together: the USGS as network designer, the Central Coast Regional Water Quality Control Board as network manager, and Monterey and San Luis Obispo county agencies as data providers. After investigating the basin's groundwater quality problems, a list of objectives was developed. These objectives were written as concise statements. The network designers and managers arranged the objectives in the order of importance and set priorities for them. An ideal network was designed to meet all of the monitoring objectives. In the ideal network exercise, budget and manpower constraints were ignored. Each monitoring location was chosen for a specific objective or group of objectives. The ideal network was compared with the existing network to identify where both more and less monitoring was needed. Then a proposed network was chosen. The ideal and existing networks were composited to produce the proposed network, but budget and manpower were considered. To keep the network at a realistic size, monitoring was only recommended to meet the most important objectives. Existing monitoring sites were retained to meet any of the objectives. (Author's abstract)
W85-06830

ANALYTICAL METHODS FOR THE PREDICTION OF LEACHATE PLUME MIGRATION,
Oklahoma State Univ., Stillwater. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W85-06831

LYSIMETERS ALLOW QUICKER MONITORING OF HEAP LEACHING AND TAILING SITES,
Environmental Services International, Denver, CO.
For primary bibliographic entry see Field 5G.
W85-06838

PRECIPITATION GAGE NETWORK OPERATIONS FOR WINTERTIME RESEARCH IN THE CENTRAL SIERRA NEVADA,
Atmospherics, Inc., Fresno, CA..
For primary bibliographic entry see Field 2B.
W85-06925

NETWORKS PLANNING FOR WATER INVESTIGATIONS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Journal of Environmental Systems, Vol. 14, No. 4, p 355-372, 1984-85. 4 Fig, 2 Tab, 30 Ref.

Descriptors: *Data acquisition, *Networks, *Planning, Netherlands, Great Britain, Groundwater, Surface waters, Wastewater, Precipitation, Monitoring.

The systematic acquisition of basic data is indispensable for all levels involved in the preparation of environmental interventions. In effect, data acquisition networks concerning water resources provide the bases on which managers and investors alike depend for determining the viability of industrial, urban, or agricultural development. Data acquisition networks permit consideration of the present and future availability of water as a function of technology. Data must be collected on surface water, groundwater, wastewaters, and precipitation. The data acquisition network must permit not only an evaluation of the quantity and quality of actual water reserves but also the determination of water availability in space and time. The methods for acquiring water quality data are analyzed, based on a case study of methods employed in Great Britain and in the Netherlands. The groups responsible for the data acquisition network are described by analyzing their objectives, techniques, successes and failures, efficiency, financial backing, personnel, and methods of data treatment. In Great Britain, the central government exercises an important control over administrative activities in the basin. The basin administrations have been given a key role in the collection and analysis of basic data and information. The Netherlands was among the first to set up governmental services to protect the environment: RID (drinking water); RIZA (wastewater treatment); and RIV (in charge of monitoring water supplies). (Moore-IVI)
W85-07098

7B. Data Acquisition

MICROCLIMATE OF A RAINFALL SHELTER,
Texas Agricultural Experiment Station, Temple. Blackland Research Center.
For primary bibliographic entry see Field 2I.
W85-06185

REGIONAL-SCALE ESTIMATES OF SURFACE MOISTURE AVAILABILITY FROM GOES INFRARED SATELLITE MEASUREMENTS,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
T. N. Carlson, F. G. Rose, and E. M. Perry.
Agronomy Journal, Vol. 76, p 972-979, November-December, 1984. 7 Fig, 1 Tab, 18 Ref.

Descriptors: *Moisture availability, *Satellite technology, *Infrared imagery, *Kansas, *Nebraska, Remote sensing, Measuring instruments, Soil water, Surface temperature, Precipitation.

A method for obtaining remotely a measure of surface moisture, called moisture availability, is derived here using satellite infrared surface temperature measurements in conjunction with a numerical boundary layer model. Results are presented largely in the form of a statistical comparison between rainfall and soil moisture patterns. The analyses demonstrate a statistically significant log-linear relationship between moisture availability, as determined from satellite infrared measurements, and the antecedent precipitation for the region of eastern Kansas and Nebraska during two summers of drought, 1978 and 1980. This result is remarkable in view of the fact that the temperature measurements are spatial averages of an immensely complex surface and substrate consisting of a wide variety of land use types and vegetation. Consistent results were obtained within the 1980 cases, and an inference can be made that the 1978 and 1980 ground conditions were different. The similarity of the results using day-night and morning-afternoon image pairs suggest that polar-orbiting satellites, such as the NOAA vehicles, would also provide satisfactory measurements for determining regional-scale patterns of soil moisture availability. (Baker-IVI)
W85-06188

SOIL SURFACE PSYCHROMETER FOR MEASURING HUMIDITY AND STUDYING EVAPORATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
V. A. Seymour, and T. C. Hsiao.
Agricultural and Forest Meteorology, Vol. 32, No. 1, p 61-70, July, 1984. 5 Fig, 11 Ref. California Dept. of Water Resources Contracts B53844 and B53812.

Descriptors: *Psychrometers, *Humidity, *Evaporation, *Soil surface, Soil water potential, Measuring instruments, Evapotranspiration, Model studies.

A field instrument is presented for determining soil surface humidity. The instrument, based on thermocouple psychrometry, is able to measure the humidity above surfaces of saturated salt solutions fairly accurately except at the highest relative humidities where the estimates were a few percentage points lower than theoretical values. Tests over soil of known water potential, hence known relatively humidity, were conducted at similar high humidities and the results showed an underestimation of similar magnitude. Field trials demonstrated that it is possible to measure the daily course of vapor pressure of the soil surface and of the bulk air as the soil dries, and to use those values to obtain the cumulative vapor pressure difference through the day. The cumulative differences appears to be a good predictor of evaporation from a soil surface in the field under natural crop conditions. (Baker-IVI)
W85-06197

PORTABLE EVAPORIMETER FOR RAPID MEASUREMENT OF THE EVAPORATION RATE OF WATER,
RCA Labs., Princeton, NJ.
For primary bibliographic entry see Field 2D.
W85-06199

QUANTIFYING EFFECTS OF ATMOSPHERIC CO2 ENRICHMENT ON STOMATAL CONDUCTANCE AND EVAPOTRANSPIRATION OF WATER HYACINTH VIA INFRARED THERMOMETRY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2D.
W85-06202

EFFECT OF VEGETATION ON SOIL MOISTURE SENSING OBSERVED FROM ORBITING MICROWAVE RADIOMETERS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2G.
W85-06215

CALIBRATION OF NEUTRON MOISTURE METERS ON STONY SOILS (NOTE),
Ministry of Agriculture and Fisheries, Ashburton (New Zealand). Winchmore Irrigation Research Station.
R. V. Stocker.
Journal of Hydrology, (New Zealand), Vol. 23, No. 1, p 34-36, 1984. 1 Tab, 2 Ref.

Descriptors: *Moisture meters, *Soil properties, *Soil water, Measuring instruments, Moisture content.

A technique is described to calibrate neutron moisture meters in soils with stone content up to 60%. The slope of the relationship between neutron count ratio and soil water content of a neutron moisture meter varies by up to 10% for a range of Canterbury stony-soil types. The method of calibration is to measure the count ratio on an in situ soil and then to determine the volumetric moisture content of the measured soil. This is repeated over a range of soil moistures to derive a linear regression between soil moisture and count ratio. Installation and procedure are described in a sample case. (Baker-IVI)
W85-06435

MISSISSIPPI RIVER OUTFLOW PATTERNS SEEN BY SEASAT RADAR,
Hawaii Inst. of Geophysics, Honolulu. Planetary Geosciences Div.
For primary bibliographic entry see Field 2L.
W85-06519

TIME DOMAIN REFLECTOMETRY FIELD MEASUREMENTS OF SOIL WATER CONTENT AND ELECTRICAL CONDUCTIVITY,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W85-06539

EXPERIENCE IN THE USE OF SATELLITE PHOTOGRAPHS FOR ENGINEERING-GEOLOGICAL CHARACTERIZATION OF CONSTRUCTION SITES OF HYDRAULIC STRUCTURES,
A. L. Strom.
Hydrotechnical Construction, Vol. 18, No. 2, p 53-55, February, 1984. 2 Fig, 5 Ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 2, p 13-15, February, 1984.

Descriptors: *Remote sensing, *Satellite technology, *Geology, Dam construction, Site selection, Reservoir siting, Earthquakes, Seismic properties, Soil properties, Satellite photography.

The selection of an optimal site is of decisive importance when constructing important hydraulic structures, especially large dams. Satellite photographs of a local level of generalization have been successfully shown to provide the necessary detail for determining many characteristics of various sites. Results are provided from satellite photos for regional and detailed characterization of engineering-geologic conditions of a valley of one of the rivers of Central Asia distinguished by a complex geological structure and, presumably an extremely high level of seismicity. The good geomorphologic expression of active faults makes it possible to identify them on the satellite photos with sufficient certainty without conducting field verification. A greater number of dislocations were detected than has been previously described in the literature. Some of them were found in the immediate vicinity of narrow stretches of the valley which with respect to their morphology are favorable for constructing dams. This attests to the increased seismic danger of such stretches, which made it possible to eliminate them from further consideration. On the basis of an analysis of satellite photos and the literature data on the geology, neotectonics, and seismicity in the investigated region, the most probable zones of occurrence of foci of strong earthquakes were established. Detailed photointerpretation made it possible to obtain an idea not only about fault tectonics and structure of the unconsolidated cover but also about jointing of the rock mass and to distinguish blocks markedly differing both in the density of joints and faults and in the number of their systems. Since jointing to a considerable extent determines such important characteristics of a rock foundation as its seepage and elastic-strength properties, the data obtained are quite important both for comparing the investigated area with other sites and for selecting the best site within it. (Baker-IVI)
W85-06589

NIMBUS-7 SMMR POLARIZATION RESPONSES TO SNOW DEPTH IN THE MIDWESTERN U.S.,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2C.
W85-06636

SURFACE TEMPERATURE VARIABILITY PATTERNS WITHIN IRRIGATED FIELDS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 3F.
W85-06688

MODIFICATIONS TO ELECTROLYTIC RESPIROMETER SYSTEMS FOR PRECISE DETERMINATION OF BOD EXERTION KINETICS IN RECEIVING WATERS,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
C. W. Hickey, and J. W. Nagels.
Water Research, Vol. 19, No. 4, p 463-470, 1985. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Respirometer, *Biochemical oxygen demand, Kinetics, Benthic oxygen, Dissolved oxygen, Toxicity, Water quality control, Monitoring.

Modifications to a commercially available electrolytic biochemical oxygen demand device, required to provide a system capable of obtaining reliable results at low levels of BOD are described. The electrolytic respirometric system produced is independent of atmospheric pressure and temperature fluctuations. Major sources of error in measurement have been minimized with careful initial temperature equilibration followed by operation with a high oxygen mass transfer coefficient, a high liquid to gas ratio within the reactor system, and with the potassium hydroxide trap removed to prevent carbon dioxide depletion. Nomographs have been presented to allow the calculation of the maximum deficit and the apparent lag time for respirometric gas exchange systems. Some apparent lag must result in such systems because of the oxygen depletion needed to trigger the electrolysis cell. (Baker-IVI)
W85-06734

FAMILY OF PNEUMATICALLY-OPERATED THIN LAYER SAMPLERS FOR REPLICATE SAMPLING OF HETEROGENEOUS WATER COLUMNS,
New Hampshire Univ., Durham. Dept. of Botany and Plant Pathology.
A. L. Baker, K. K. Baker, and P. A. Tyler.
Hydrobiologia, Vol. 122, No. 3, p 207-211, March, 1985. 5 Fig, 4 Ref.

Descriptors: *Samplers, *Thin layer samplers, Stratification, Microstratification, Water analysis.

Characteristics and field performance of a series of four pneumatically-operated thin layer samplers (TLS) are described. All models of TLS employ 60 ml transparent plastic syringes. The samplers can be operated from small boats, and permit sampling at 2.5-cm intervals with little or no disturbance of stratified systems such as oxyclines or redoxclines of meromictic lakes, or microstratification of flagellates in sheltered epilimnia. Performance of the samplers is illustrated by the examples of distribution of in vivo fluorescence attributable to a population of chloromonad flagellates, and vertical profiles of pH, measured electrochemically in the field, and of dissolved oxygen, in a lake. Multiple-row versions of the samplers permit replicate sampling at close intervals in a two-dimensional array, for statistical purposes or for simultaneous sampling of more than one chemical, physical, or biological parameter, with the assurance that the horizontal relationships among parameters are maintained. (Rochester-IVI)
W85-06787

APPLICATION OF LANDSAT SATELLITE DATA FOR MAPPING AQUATIC AREAS IN NORTH-EASTERN FINLAND,
Oulu Univ. (Finland). Dept. of Astronomy.
J. Raitala, H. Jantunen, and J. Lampinen.
Aquatic Botany, Vol. 21, No. 3, p 285-294, March, 1985. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Satellite technology, *Mapping, *Finland, *Lake Yli-Kitka, *Lake Posionjarvi, Multispectral scanners, Computers, Remote sensing, Vegetation, Wetlands, Aquatic plants, Turbidity.

Aquatic phenomena and complexes were extracted from Landsat multispectral scanner (MSS) data obtained from images of western Lake Yli-Kitka and Lake Posionjarvi, Finland. Lake subscenes of the Landsat MSS data 206-13 of 15 July 1979, consisting of four spectral bands (Band 4, 500-600 nm, Band 5, 600-700 nm, Band 6, 700-800 nm, and Band 7, 800-1, 100 nm) were cut and processed using the Univac 1100/22 computer system and relevant calculation packages. Classes identified by symbols and used for delineation of areas within the lakes were, for Yli-Kitka, open lake (with four subgroups based on depth, Secchi disc depth, and vegetation), shallow muddy-bottomed wetlands, wetlands vegetated with helophytes in shallow water, and densely vegetated shore, including some geolittoral mixed pixels. For Lake Posionjarvi, three classes were used: turbid, dystrophic open lake, shoaly with sparse nymphaeids; extremely turbid water, shallow vegetated area with muddy bottom; and complex of small islets and shallow water, densely vegetated, shallow, with a muddy shore. The mapping method is valid for large surface areas only. In some cases it seemed to be impossible to separate thin aquatic vegetation from turbid water. The need for aquatic area classification and mapping improvement mostly arises from the large (0.5 ha) pixel area on the surface, and the width of MSS sensor spectral bands, which allow only surface complexes of large area to be identified. The main application of Landsat mapping should be in preparing multitemporal studies over large areas. (Rochester-IVI)
W85-06805

COMPARISON OF SAMPLING MECHANISMS AVAILABLE FOR SMALL-DIAMETER GROUND WATER MONITORING WELLS,
IEP, Inc., Worthington, OH.
For primary bibliographic entry see Field 2F.
W85-06834

EFFECT OF TILT ON SEDIMENT TRAP EFFICIENCY,
Lamont-Doherty Geological Observatory, Palisades, NY.
W. D. Gardner.
Deep-Sea Research, Vol. 32, No. 3, p 349-361, March, 1985. 5 Fig, 2 Tab, 30 Ref.

Descriptors: *Tilt, *Sediment traps, *Hudson River, *New York, Sediment transport, Sediment sampler, Trap efficiency, Boundaries.

Cylindrical traps with an aspect ratio of 5.2 were tilted from 0 degrees to 70 degrees upstream and downstream in the Hudson River with currents ranging between 2 and 62 cm/s. Particle flux in the tilted traps increased with tilt up to about 45 degrees where overcollection reached a maximum factor of three but decreased beyond 45 degrees when traps were tilted downstream. There was no discernible velocity effect on the total flux collected with tilted traps. In a recirculating flume, dye used as a water tracer revealed the existence of boundary layers within traps. The exchange of particles across the boundaries appears to play an important role in controlling the collection rate of particles and the conditions during which traps over- and under-collect particles. The tilt effect on traps is important, not only where high velocities can cause a mooring to lean, but also where high-frequency internal waves might pass either moored or freefloating traps since the vertical velocity component of an internal wave can cause an effective tilt of the traps. (Author's abstract)
W85-06850

AERIAL SURVEY TECHNIQUES TO MAP AND MONITOR AQUATIC PLANT POPULATIONS: FOUR CASE STUDIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
E. A. Dardeau.
Technical Report A-83-1, January 1983. Final Report. 49 p, 16 Fig, 4 Tab, 11 Ref.

Descriptors: *Aerial photography, *Aquatic plants, *Infrared imagery, *Aquatic populations, *Mapping, *Plant populations, *Case studies, *Macrophytes, Surveys, Watermilfoil, Hydrilla, Submerged plants.

From 1977 to 1981, the U.S. Army Engineer Waterways Experiment Station conducted numerous aerial survey studies in conjunction with the U.S. Army Corps of Engineers Aquatic Plant Control Research Program to develop unique photointerpretation and mapping procedures and computer software for processing aerial survey maps of aquatic macrophyte populations. Four of these studies are highlighted in this report. At the Lewis Creek Reservoir, Texas, a comparison was made of automated and manual techniques to compute areal coverage of hydrilla on two scales of aerial photography. A comparison of boat and aerial surveys of giant cutgrass was conducted at Lake Seminole, Alabama-Florida-Georgia. At Gatun Lake, Panama, the growth of hydrilla in a tropical environment was studied by aerial techniques. At Lake Osoyoos, Washington, the changes in a community dominated by Eurasian watermilfoil were studied over a 1-yr period. These four case histories provide examples of the use of three scales/ranges of nominal scale of aerial photography to detect and map the distribution of submerged aquatic plant populations. Photointerpretation of smaller scale imagery (1:24,000) was more difficult than the scales used in the case studies. Regardless of scale, submerged populations were easier to detect on color than on color infrared imagery. Emergent plants were easier to detect on aerial imagery than submerged plants.
W85-06955

INSTRUMENT FOR THE IMMEDIATE QUANTIFICATION OF BACTERIA IN POTABLE WATERS,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5A.
W85-07130

APPLICATION OF A SIMPLIFIED METHOD FOR RECOVERY OF YERSINIA ENTEROCOLITICA FROM SURFACE WATERS,
Aquila Univ. (Italy). Ist. d'Igiene.
For primary bibliographic entry see Field 5A.
W85-07135

7C. Evaluation, Processing and Publication

MATRIX AND ACCOMPANYING CLASSIFICATIONS FOR IDENTIFYING WATER RESEARCH PROBLEMS AND NEEDS,
Ohio Agricultural Research and Development Center, Wooster.
For primary bibliographic entry see Field 6A.
W85-06246

POWER OF THE ELECTRONIC WORKSHEET: MODELING WITHOUT SPECIAL PROGRAMS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
For primary bibliographic entry see Field 2F.
W85-06828

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 7: MANAGEMENT OF ECOLOGICAL DATA IN LARGE RIVER ECOSYSTEMS,
Army Engineer Waterways Experiment Station,

Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W85-06899

COMPUTER-ASSISTED DATA PROCESSING AND ANALYSIS SYSTEM FOR GROUND-BASED METEOROLOGICAL DATA COLLECTION,
Atmospherics, Inc., Fresno, CA..
R. Allan, S. Barnes, M. Solak, and T. Henderson.
Technical report AISCP-842, June 1984. 47 p, 11 Fig, 2 Photos, 7 Ref, 5 Append. Contract/Grant No. 9-07-85-V0020.

Descriptors: *Data acquisition, *Data processing, *Weather modification, *Computers, Computer programs, Sierra Cooperative Pilot Project, Quality control, Meteorological data collection, Data collections, Graphical analysis, Statistical analysis.

A computer system was developed to aid in processing and analysis of data collected from ground-based instrument systems in the Sierra Cooperative Pilot Project. Included are the primary programs used in data processing and analysis, quality control in data processing, and a complete listing of all programs used in the project.
W85-06924

BASIC HYDROLOGY,
Memorial Univ. of Newfoundland, St. John's.
For primary bibliographic entry see Field 2A.
W85-06931

8. ENGINEERING WORKS

8A. Structures

EMPINGHAM DAM - DESIGN, CONSTRUCTION AND PERFORMANCE,
For primary bibliographic entry see Field 8D.
W85-06174

EMPINGHAM RESERVOIR - SEEPAGE CONTROL MEASURES,
For primary bibliographic entry see Field 8E.
W85-06175

CURRENT STATE AND PROBLEMS OF IMPROVING OPERATIONAL MONITORING OF THE SAFETY OF HYDRAULIC STRUCTURES,
E. K. Aleksandrovskaya.
Hydrotechnical Construction, Vol. 18, No. 9, p 405-409, September, 1984. 3 Tab, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 20-23, September, 1984.

Descriptors: *Safety, *Hydraulic structures, *Hydraulic equipment, *Monitoring, Measuring instruments, Dams, Automation, Inspection.

The experience of on-site observations and investigations at large dams, particularly at the Krasnoyarsk and Sayano-Shushenskoe, shows that the main problems of improving the organization and conduction of such observations and investigations to increase their effectiveness are as follows. The development of an optimal (unified for construction and operational monitoring) layout of the telemetric monitoring and measuring apparatus (MMA), should lead to a reasonable reduction of the number of instruments. Provision must be made for high quality installation of MMA and equipment of the control panels at all hydrostations under construction. The quality of sensors and frequency meters being manufactured must be improved. The development of automated systems providing for both automation of measurements and processing and analysis of the data of on-site observations with delivery of signals about emergency and preemergency situations must be accelerated. Skilled inspection of the safety of hydraulic structures must be provided starting from the instant of the first filling of the reservoir. (Baker-IVI)
W85-06707

POINTE COUPEE PUMPING STATION SIPHON UPPER POINTE COUPEE LOOP AREA, LOUISIANA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120159. Technical Report HL-82-21, September, 1982. Final Report. 35 p. 9 Tab, 6 Photos, 9 Plates, 15 Ref.

Descriptors: *Hydraulic models, *Pumping plants, *Siphons, Deflection, Model Studies, Head loss, Tailwater.

Hydraulic models were used to evaluate the hydraulic performance of the Pointe Coupee, Louisiana, pumping station siphon. A trap design was developed to ensure maintenance of the priming seal and to prevent excessive negative pressures at the siphon crown. The diameter of the siphon was reduced to obtain adequate priming velocities. Use of deflectors to induce priming was also tested. Pressure fluctuations and head losses were measured in the model. There is a definite scale affect in modeling a water and air mixture. The priming times in prototypes will be less than those observed in models. Conversely, the discharge that will wash out priming seal may be underestimated by a model. It is prudent, therefore, to provide a safety factor in the design of a vented trap's height. Siphon models should be constructed large enough to ensure reasonable air transport and to minimize scale effects. The recommended design siphon operated satisfactorily for the entire range of expected tailwaters and discharges.
W85-06961

SUMMARY REPORT: MODEL-PROTOTYPE COMPARISON STUDY OF DIKE SYSTEMS, MISSISSIPPI RIVER; POTAMOLOGY INVESTIGATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. J. Franco.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120144. Technical Report HL-82-11, May 1982. Final Report. 55 p. 30 Plates.

Descriptors: *Dikes, Prototypes, River mechanics, Hydraulic models, Mississippi River, Model studies.

Movable-bed model studies were conducted on seven of the most complex and troublesome reaches of the Mississippi River to obtain some quick general indications of the effectiveness of plans proposed for the improvement and stabilization of those reaches. The studies were conducted in an existing facility with little or no adjustment of the models and in some cases without a base test. Because of the limited size and shape of the facility, only a relatively short reach of the river including the problem could be reproduced in each model with little or no overbank areas. The horizontal scale varied with each depending on its size and shape and was much smaller with a higher distortion of the linear scales than is considered desirable for studies of this type. An analysis of the model results compared with developments in the river based on an evaluation of considerable prototype data indicated that the types of models used predicted most of the principal trends that actually occurred in the river with the plans tested. The degree of accuracy of the models varied and depended on the model adjustment, characteristics of the reach, flow conditions, and similarity between plan tested and actual construction. The analysis of model and prototype data permitted an evaluation of the performance of various types of dikes and dike systems and some of the principles involved in the developments within alluvial streams.
W85-06962

USER'S GUIDE: COMPUTER PROGRAM FOR DESIGN OR INVESTIGATION OF ORTHOGONAL CULVERTS (CORTCUL),
Dawkins (William P.), Stillwater, OK.
W. P. Dawkins.
Instruction Report K-81-7, March 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 191 p, 20 Fig, 3 Tab, 5 Ref, 3 Append. Contract/Grant No. DACW39-80-M-0334.

Descriptors: *Computer programs, *Computers, *Culverts, Design criteria, Design standards, Concrete, Stress analysis, Reinforced concrete.

This user's guide describes a computer program called 'CORTCUL' that can be used for design or investigation of orthogonal, reinforced concrete culverts by either working stress design (WSD) or strength design (SD) procedures. In the design mode, the program determines the required thicknesses and reinforcement areas for given soil loadings and culvert opening sizes. In the investigation mode, material stresses or factors of safety are calculated for specified structural geometries and loadings. The program was developed from specifications furnished by the Corps of Engineers' Computer Aided Structural Engineering (CASE) Task Group on Culverts and Conduits. It is written in Fortran and data may be provided either interactively from the user's terminal during execution or from a previously prepared data file. Input data are checked for consistency at the time of entry. Results generated in the design mode are presented in three parts: design thickness, design reinforcement areas, and design member load/force data. Investigation results are separated into two parts: summary of results and member load/force results.
W85-06985

RIPRAP STABILITY UNDER WAVE ACTION,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-07079

SCALING THE WEIGHT OF BREAKWATER ARMOR UNITS,
Memorial Univ. of Newfoundland, St. John's. Faculty of Engineering and Applied Science.
J. J. Sharp.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 111, No. 3, p 594-597, May, 1985. 4 Ref.

Descriptors: *Mathematical equations, *Model studies, *Breakwaters, Waves, Kinetics, Viscosity, Density, Oceans, Slopes, Froude number, Gravity, Velocity.

A mathematical equation is presented for calculating the weights of individual model armor units. Some general conclusions regarding the formulation of model laws are also presented. In some equations the implication is made that the density ratio should be the same in model and prototype. This is not necessarily so in practice. There is much evidence to suggest that this requirement may, within certain limits, be relaxed when dealing with densimetric flows. If the density ratio is permitted to vary, then great care should be taken in using any dimensionless parameter containing it, as a basis for formulating a model law. From the analysis as presented it is fairly obvious that it is not permissible to use a particular term for compounding, and then drop it from the list of model laws if the compounded term is to be used as a model law itself. Such compounded terms may arise directly from the dimensional analysis without having undergone any formal compounding process. Terms of this type are particularly prevalent if the analysis is performed using a reduced gravitational acceleration as is common in densimetric studies. This study has served to indicate the danger of using such terms of modeling without having due regard to their composition or to the other terms appearing in the dimensionless list. (Baker-IVI)
W85-07081

HYDRODYNAMIC PRESSURE ON SHORT-LENGTH GRAVITY DAMS,
Johns Hopkins Univ., Baltimore, MD.
A. A. Rashed, and W. D. Iwan.

Journal of Engineering Mechanics, Vol. 110, No. 9, p 1264-1283, September, 1984. 10 Fig, 3 Tab, 7 Ref.

Descriptors: *Hydrodynamic pressure, *Gravity dams, Vibration, Ground motion, Mathematical equations, Compressibility, Waves.

Analytical expressions are derived for the hydrodynamic pressures generated in reservoirs behind short-length gravity dams, and resulting from vibrational motions of the dam and ground motions. The dams have vertical upstream faces. The reservoirs are assumed to have rectangular cross-sections, constant depths and to extend to infinity in the upstream direction. Water compressibility is taken into consideration, and solutions of the three-dimensional wave equation are obtained under both flexible and rigid boundary assumptions. The formulas obtained are used to calculate the hydrodynamic pressure for a range of geometries, and the results are presented in a form that clearly shows its dependence on the various parameters of the problem. The effect of the length to height ratio of the dam, and the significance of the cross-stream and vertical components of ground motion on the pressure response are investigated. (Author's abstract)
W85-07102

8B. Hydraulics

EFFECTIVE USE OF COOLING LAKES AND COOLING TOWERS IN HYBRID COOLING SYSTEMS,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
T. W. Sturm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157675/AS, Price codes: A05 in paper copy, A01 in microfiche. Environmental Resources Center Report No. ERC 07-84, Georgia Institute of Technology, Atlanta, September 1984, 62 p, 1 Fig, 1 Tab, 23 Ref, Project No. USGS G-836 (07).

Descriptors: *Cooling lake, *Cooling tower, Evaporation, Hybrid cooling, *Power plant, *Stratification, Water resources.

The research summarized in this report analyzes the consequences of the use of hybrid cooling systems for the dissipation of waste heat from thermoelectric power generation. The hybrid cooling system studied consists of a combination of cooling towers and a cooling lake to receive a specified heat load. A transient computer simulation model of both the cooling lake stratification and the cooling tower thermodynamic performance is developed. The model is calibrated and verified with field data. Simulations of various combinations of cooling lake and cooling tower capacities for a given power plant heat load are conducted to determine the effect on lake thermal structure, total water loss by evaporation, and power plant intake temperatures. An optimum strategy for hybrid cooling system design is suggested based on these simulation results.
W85-06314

CHARTS FOR WATER HAMMER IN HIGH HEAD PUMP DISCHARGE LINES RESULTING FROM PUMP FAILURE AND CHECK VALVE CLOSURE,

British Columbia Univ., Vancouver. Dept. of Civil Engineering.
E. Ruus, and B. Karney.
Canadian Journal of Civil Engineering, Vol. 12, No. 1, p 137-149, March, 1985. 10 Fig, 4 Ref.

Descriptors: *Pipelines, *Water hammer, *Pump failure, *Check valves, Valves, Failure, Pressure head, Pumps, Computers, Inertia.

Maximum pressure head drops and rises resulting from pump failure and subsequent check valve closure are calculated and plotted for a simple pump discharge line at pump end, midpoint, and three-quarter point. Basic parameters such as pipeline constant, pipe wall friction, complete pump characteristics, and pump inertia constant are accounted for in the analyses. Computer studies indicate that pipe friction, pipeline constant, and pump inertia have a major effect on pressure head drops and rises. Friction substantially increases the downsurge condition. Friction largely reduces upsurge. In pipelines with large fricton, the upsurge may never reach the initial steady state hydraulic grade line. Studies also indicate that whereas for large pump inertia the pressure head rise or drop at the midpoint is only moderately larger than one-half of the rise or drop at pump end, for small pump inertia this difference is much greater. For very small pump inertia, the pressure head drop or rise at midpoint approaches the values at pump end. This increase in pressure head drop and rise for very small pump inertia is even more pronounced at the three-quarter point. (Baker-IVI)
W85-06552

OPTIMALLY CONTROLLED HYDRODYNAMICS FOR TIDAL POWER IN THE SEVERN ESTUARY,

Bristol Polytechnic (England). Dept. of Computer Studies and Mathematics.
S. C. Ryrie, and D. T. Bickley.
Applied Mathematical Modelling, Vol. 9, No. 1, p 2-10, February, 1985. 5 Fig, 15 Ref.

Descriptors: *Hydrodynamics, *Tidal powerplants, *Estuaries, *Severn Estuary, *England, Barrages, Model studies, Tidal energy, Design criteria, Mathematical equations.

A representation of the hydrodynamics of a wedge-shaped tidal estuary, involving the integration of a set of ordinary differential equations, is developed and applied to the Severn Estuary, with an energy-extracting barrage present on a line from Brean Down to Lavernock Point. An attempt is made to model the interaction between an optimized energy-extracting tidal barrage and the tidal dynamics of the estuary in which it is situated. The hydrodynamic model used is sufficiently simple to allow the successful formulation of the optimal control, while still giving a realistic description of the tidal dynamics of the estuary. This model has been used in conjunction with numerically accurate characteristics for the machinery of the proposed Severn Barrage, operating in ebb general mode. The major effect of tidal dynamics on the scheme studied is the reduction in tidal range immediately outside the barrage by between 7 and 10%. This leads to a reduction in predicted energy output of between 10 and 17% from that found by a flat-surface model using the existing tidal regime of the estuary. The basin itself, when used in ebb generation mode, appears to be little affected by tidal dynamics, as far as these affect energy output. This appears to be due to the fact that disturbances produced at the barrage travel up the basin and back in a time much less than the duration of generation. In this sense, the basin of the proposed Severn Barrage scheme is too deep and short to allow its tidal dynamics greatly to affect energy output, when ebb-generation is being used. It may be possible to take advantage of the tidal dynamics of the basin by using other operating modes, particularly if pumping is included. (Baker-IVI)
W85-06560

PRESSURE TRANSIENTS CAUSED BY SLAMS AND BURSTS IN WATER PIPELINES,

E. P. Evans, and P. V. Sage.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 1, p 58-70, February, 1985. 13 Fig, 11 Ref.

Descriptors: *Pipelines, *Water hammer, *Pressure, Valve slams, Pipe bursts, Earthquakes, Pump failure, Water distribution, Water mains.

A data steered modular waterhammer program is described which can be used to predict transient behavior in many different closed conduit systems. The program is based on the concentrated cavity conceptual model. Particular problems in two such systems are identified and described. The first problem arises from the routing of a large gravity main conveyor in a seismically active area. Protection has to be provided against possible earthquake induced pipeburst. In particular, the possibility of transient amplification in the smaller branches must be guarded against. The second problem concerns the subject of reflux valve slam, the slam ocurring after pump failure on a high head scheme. In each problem, it is evident that the physical behavior of hydraulic devices, whether they be over-velocity valves or pumps, reflux valves and air vessel combinations are of fundamental importance. As such, an awareness of the physical behavior of any such device will always be the design engineer's main consideration whatever techniques of analysis are available. (Baker-IVI)
W85-06576

HYDRAULIC FORCES ON RAILS FOR VERTICAL LIFT, HIGH HEAD GATES,

For primary bibliographic entry see Field 8C.
W85-06579

TRANQUIL AND RAPID FLOWS IN SMOOTH-WALLED AND REINFORCED-CONCRETE FLUME CHANNELS,

O. M. Aivazyan.
Hydrotechnical Construction, Vol. 18, No. 2, p 96-104, February, 1984. 4 Fig, 1 Tab, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 43-47, February, 1984.

Descriptors: *Hydraulic resistance, *Hydraulic roughness, *Reinforced concrete, *Tranquil flow, *Rapid flow, Flumes, Channels, Hydraulic gradient, Hydraulic radius, Darcy coefficient.

The hydraulic resistance characteristics of tranquil and rapid flows in smooth-walled and reinforced-concrete flume channels were investigated. A quantitative correlation relating the hydraulic resistance to the hydraulic gradient and the hydraulic radius was derived based on the data obtained from laboratory-scale smooth-walled flumes and actual reinforced-concrete flume channels. A quantitative correspondence between the predicted values and the observed values from various prototype pipes and flumes was found. Based on the analysis performed, it is noted that: (1) in the case of tranquil flow in smooth-walled flumes, a law of resistance qualitatively coinciding with the law of smooth pipes is observed; (2) in the case of tranquil flow in reinforced-concrete channel flumes the Darcy coefficient (C) increases with increased relative roughness; and (3) in the case of rapid flow in smooth-walled flumes and reinforced-concrete channel flumes the Darcy coefficient decreases with increased relative roughness. (Shieh-IVI)
W85-06597

ENTRANCE RESISTANCE OF ENVELOPED DRAINAGE PIPES,

Bangladesh Agricultural Development Corp., Jessore.
M. A. Sekendar.
Agricultural Water Management, Vol. 8, No. 4, p 351-360, February, 1984. 3 Fig, 5 Tab, 13 Ref.

Descriptors: *Drainage pipes, *Entrance resistance, *Enveloped pipes, Drain spacing, Flow resistance, Pipes, Subsurface drainage.

Envelope materials protect drainage pipes from silting up, and also have the hydrological function of reducing the entrance resistance. In most drainage equations applied for calculating drain spacing, an ideal drain is assumed and hence the entrance resistance is not taken into account. The entrance resistance and the effective radius of corrugated PVC drain pipes without envelope and with six different prewrapped envelopes were evaluated in a sand tank experiment. By applying the theory of resistances, the entrance resistance of the naked pipe was found to be 0.0136 days/m. The entrance resistance of naked drain pipe was reduced by the use of all envelopes and reduced considerably with a highly permeable voluminous envelope material. With envelopes, the values were 0.0024 to 0.0067 days/m, depending on the types of envelope. The effective radius of the naked pipe was 0.47 cm for a drain pipe with an actual radius of 3.0 cm. This value increased to between 1.20 and 2.50 cm when envelope material was used. The values of the

calculated entrance resistances were substituted in the steady state drainage equations under normal field conditions to evaluate the effect on drain spacing. Use of envelope materials theoretically allows an increase in drain spacing, but not appreciably. (Moore-IVI)
W85-06682

EFFECT OF MOLE SUBMERGENCE ON THE LIFE OF MOLE CHANNELS,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experiment Unit.
G. L. Harris.
Agricultural Water Management, Vol. 8, No. 4, p 361-374, February, 1984. 9 Fig, 2 Tab, 16 Ref.

Descriptors: *Mole drainage, *Submergence, *Mole channels, Subsurface drainage, Pumped drainage, Hydrologic properties, Mole failure.

It has been suggested that submergence of mole channels in field drainage systems will cause their premature collapse and lead to a failure of the system. Limited experience on Field Drainage Experimental Unit's sites has not supported this view. An experiment was set up on a clay soil with a good moling potential, and where a previous moling had lasted up to 5 years. In a pumped drainage scheme submergence was examined to determine if it was a cause of mole channel failure. Isolated plots were subjected to short (usually less than 3 h) and long periods (up to 20 days) of submergence. The hydrological performance and the condition of the mole channels was monitored for 5 years. Short periods of submergence did not appear to have a substantial effect on the mole drainage system and a 4-5-year life of the mole channels could be expected. Longer periods of submergence did not cause any immediate deterioration but the gradual collapse of the roof and side walls, which was the normal mode of failure, became more accentuated. This effect reduced the life of the mole channels to 3-4 years, although 3 years after moling the watertable control of the submerged plots was substantially better than similar adjacent undrained land. (Author's abstract)
W85-06683

DETERMINATION OF THE FLOW RATE IN A PRESSURE PIPE BY MEASURING THE VELOCITY AT ONE POINT OF A CONVERGENT NOZZLE EXIT SECTION,
B. M. Levin, and A. N. Lopatin.
Hydrotechnical Construction, Vol. 18, No. 9, p 427-437, September, 1984. 11 Fig, 1 Tab, 20 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 39-46, September, 1984.

Descriptors: *Flow rates, *Pipes, *Convergent nozzle exit, Pressure conduits, Velocity, Flow measurement, Hydraulic systems, Turbulence.

The flow rate of a fluid flowing in a hydraulic system is a factor determining the efficiency of its action and is also one of the main regulation and control parameters. The optimal parameters of a convergent nozzle were determined experimentally. The manufacture of conical convergent nozzles is considerably simpler than the manufacture of special nozzles, the generatrices of which are defined by complex curves. Convergent sections of a pressure pipe can be used for simplifying and improving the determination of flow rate by the velocity area method. In the exit section of the convergent nozzle the velocity can be measured practically at any point of the cross section. Such a possibility simplifies the measurement technique, increasing the accuracy of determining the flow rate. Measurement of the velocity and fluctuations of the longitudinal velocity component by a laser-Doppler flowmeter made it possible to determine a number of turbulent characteristics after the exit section of the convergent nozzle. The maximum intensity of turbulent fluctuations of the longitudinal velocity component occurs at a distance of 200 to 300 micro-m from the wall and amounts to 10-12% in the range of Reynolds numbers of the flow 800,000-900,000. In the core of the flow the intensity of turbulence is 2%. These values are an order less than in a uniform turbulent air flow. (Baker-IVI)
W85-06709

USE OF SWIRLED FLOWS IN TUNNEL SPILLWAYS,
B. A. Zhivotovskii.
Hydrotechnical Construction, Vol. 18, No. 9, p 443-446, September 1984. 3 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 50-52, September, 1984.

Descriptors: *Tunnel spillways, *Swirled flow, Spillways, Hydroelectric plants, Kinetic energy, Energy dissipation, Velocity, Cavitation, Tunnels.

In tunnel spillways of high-head hydrostations the water velocity can reach values of 50-70 m/sec at heads of 300-400 m. Under these conditions a number of problems related to hydraulics of tunnel spillways arise. The main problems are: protection of the tunnel lining from cavitation erosion and dissipation of the excess kinetic energy of the flow in the conduit. For high head hydrostations the problem arises of dissipating the excess kinetic energy of the flow inside the tunnel or reducing the velocity and, consequently, the capacity of the tunnel spillway. An effective method of dissipating the kinetic energy of the flow is that of using a swirled flow behind a swirl gate. In the case of a swirled flow in a pressure tunnel spillway an intense dissipation of the kinetic energy of the flow and a marked increase of pressure on the conduit wall are provided, which lessens or eliminates the danger of cavitation. Suggestions on the development of the method with the use of swirled flows, in particular, devices for dissipating the excess kinetic energy of the flow inside the tunnel and a spillway device combining the functions of kinetic energy dissipation and discharge regulation are examined. One of the important problems in the operating of these devices is the effectiveness of dissipating the energy of the flow. (Baker-IVI)
W85-06711

MODEL-PROTOTYPE COMPARISON STUDY OF DIKE SYSTEMS, MISSISSIPPI RIVER: POTAMOLOGY INVESTIGATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. J. Franco.
Technical Report HL-82-10, May 1982. Final Report. 343 p, 123 plates.

Descriptors: *Model studies, *Stream stabilization, *Dikes, *Navigable rivers, *Project planning, *Prototype tests, *Water resources development, Stable channels, Projections, Predictions, Prototypes, Alluvial rivers.

In connection with the Mississippi River Commission Potamology Program, movable-bed model studies were conducted of seven of the most complex reaches of the Mississippi River to assess the effectiveness of plans proposed for the stabilization of those reaches. Because of the limited size of the test facility, only a relatively short reach of the river including the problem could be modeled with little or no overbank areas. The linear scales were distorted to an undesirable extent. Analysis of model results showed that qualitative predictions could be made of most of the principal trends that actually occurred in the river with the plans tested. The degree of accuracy of the models varied and depended on the model adjustment, characteristics of the reach, flow conditions, and similarity between plan tested and actual completed structures. The analysis of model and prototype data allowed an evaluation of the performance of various types of dikes and dike systems as well as an assessment of the principles involved in the developments within alluvial streams.
W85-06892

FILLING AND EMPTYING SYSTEM, WALTER BOULDIN LOCK, AND LOCK CULVERT VALVE FOR COOSA RIVER WATERWAY, ALABAMA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. F. George.
Technical Report HL-84-8, September 1984. Final Report. 156 p, 6 Fig, 36 Tab, 7 Photos, 44 Plates.

Descriptors: *Hydraulics, *Valves, *Locks, *Flow control, Hydraulic models, Model studies, Hydraulic engineering, Walter Bouldin Lock, Coosa River Waterway, Alabama, Waterways, Culverts.

A 1:25-scale model of the Walter Bouldin Lock, Coosa River, Alabama, and a 1:15-scale model of the lock culvert valve were used to study the filling and emptying system, which consisted of a bottom longitudinal flood culvert system. Culverts in each lock wall are connected to a crossover culvert with a horizontal splitter wall dividing flow to upstream and downstream tuning forks where equal divisions lead into the two longitudinal floor culverts in each end of the lock chamber. Filling and emptying time in the prototype was estimated from the model studies to be 12.7 min and 14.1 min, respectively. The key to energy dissipation and control was the unsymmetrical baffling around the floor culvert manifolds. The system is insensitive to misoperation of the valves. The reverse tainter valve for controlling the flow entering and leaving the locks is a vertically framed valve with 18-in.-deep T-beams separating the skin plate from the main horizontal girders. The average horizontal and vertical forces exerted on the trunnions ranged up to 1500 kips and 580 kips, respectively, with a lift of 130 ft. The dynamic loads on the hoist mechanism were considered excessive. Modifications to the valve did not reduce the dynamic loads, leading to the conclusion that a significant change in design may be necessary for valves subjected to lift loads as high as 130 ft.
W85-06896

KAHOMA STREAM CHANNEL IMPROVEMENT PROJECT, MAUI, HAWAII: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 4A.
W85-06904

MISSISSIPPI SOUND WAVE-HINDCAST STUDY: MAIN TEXT AND APPENDICES A AND B,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2E.
W85-06912

EROSION CONTROL OF SCOUR DURING CONSTRUCTION; REPORT 5: EXPERIMENTAL MEASUREMENTS OF REFRACTION AND DIFFRACTION DOWNCOAST OF AN OBLIQUE BREAKWATER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
L. Z. Hales.
Technical Report HL-80-3, September 1984. 140 p, 16 Fig, 19 Tab, 9 Photos, 50 Plates, 37 Ref, 2 Append.

Descriptors: *Hydraulics, *Erosion control, *Coastal engineering, *Breakwaters, *Wave height, *Shore protection, Scour, Water currents.

A hydraulic model was used to study the wave heights downcoast of an obliquely oriented (60 degrees) shore-connected breakwater under the combined effects of refraction and diffraction. The theoretical and experimental data compared favorably for the wave heights tested in the shadow zone, but they diverged with an increase in incident wave height farther downcoast out of the shadow zone.
W85-06920

JET ENTRAINMENT IN PUMPED-STORAGE RESERVOIRS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
P. J. Roberts.
Technical Report E-81-3, March 1981. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Wa-

terways Experiment Station, Vicksburg, MS. 63 p, 14 Fig, 35 Ref, 1 Append.

Descriptors: *Hydraulics, *Literature review, *Entrainment, *Reservoirs, *Pumped storage, *Flow characteristics, *Jets, Plumes, Model studies, Mathematical models, Stratified flow, Stratification, Buoyancy.

A literature review of mathematical models for predicting jet entrainment in pumped storage reservoirs revealed that no single model was adequate in all cases. However, each flow situation can be classified and entrainment predicted using the techniques described in this report. Flows were classified according to primary and secondary systems, producing 16 possible flow types. The primary classification scheme depended on the source buoyancy and boundary proximity in which 4 classes exist (buoyant immersed jet, nonbuoyant immersed jet, buoyant boundary jet, and nonbuoyant boundary jet). The secondary classification depended on the ambient stratification (stratified or uniform) and source geometry (slot or round orifice). Each situation was reviewed separately and a method for predicting entrainment presented.
W85-06921

SOUTH FORK TILLATOBA CREEK DROP STRUCTURE, MISSISSIPPI: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. E. Hite, and G. A. Pickering.
Technical Report HL-82-22, September 1982. Final Report. 78 p, 3 Fig, 1 Tab, 37 Photos, 21 Plates.

Descriptors: *Hydraulic structures, *Erosion control, *Stream erosion, *Bank erosion, *Channel erosion, *Flow control, Tillatoba Creek, Mississippi, Bank stabilization, Stilling basins, Riprap, Spillways, Weirs, Detention basins, Hydraulic models, Model studies, Drop structures.

A two-stage reinforced concrete grade control structure was proposed to prevent the rapid channel degradation and severe stream bank erosion in the South Fork of Tillatoba Creek, Mississippi. Tests were conducted on a 1:29-scale section model of the low-stage structure and a 1:25-scale model of the grade control structures to evaluate the proposed design. Flow conditions were improved by modifying the original design. Energy dissipation in the low-stage structure stilling basin was improved by adding a trajectory curve type of drop. Approach wing walls improved flow conditions in the high- and low-stage structure stilling basins. The widths of the exit channels for both structures were reduced. The preformed scour hole was eliminated, and stable riprap designs were devised.
W85-06923

LOS ESTEROS SPILLWAY, PECOS RIVER, NEW MEXICO: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
B. P. Fletcher.
Technical Report HL-82-24, October 1982. Final Report. 56 p, 11 Fig, 1 Tab, 15 Photos, 15 Plates.

Descriptors: *Hydraulic structures, *Spillways, *Dams, *Flow control, Deflection, Hydraulic models, Model studies, Los Esteros Spillway, Pecos River, New Mexico, Erosion, Surges, Turbulent flow, Rock fill, Reservoirs, Maximum flow, Ravines.

Tests to investigate the hydraulic performance of the Los Esteros Spillway and discharge channel were conducted using a 1:80-scale model. Emphasis was placed on the development of a design that would pass flows as high as 430,000 cfs without subjecting the downstream dam embankment to excessive surges and current velocities. Approach flows and flows passing over the crest were satisfactory for all anticipated discharges. Discharges above 225,000 cfs induced adverse currents, surges, and stone failure on the downstream face of the dam. Portions of the ravine or discharge channel were excavated and the amount of turbulence, surges, and currents along the downstream face of the dam was reduced to an acceptable level. However, the cost of prototype excavations was considered excessive. Properly designed flow deflectors in the ravine were effective in reducing adverse hydraulic conditions at the downstream dam embankment. The deflectors shifted flow away from the dam and down the Pecos River. A fixed deflector (concrete wall) was effective but considered undesirable for economic reasons. The design adopted by the Albuquerque District consisted of a rock deflector in the ravine and a rock fill on the dam embankment constructed of material obtained from the spillway excavation. Although the model indicated that portions of the sacrificial type rock fill would be displaced when subjected to flows above 225,000 cfs, the safety of the dam was not endangered by discharges as high as the design flow of 430,000 cfs. (Author)
W85-06927

METHOD TO FORECAST SEDIMENTATION RATES RESULTING FROM THE SETTLEMENT OF SUSPENDED SOLIDS WITHIN SEMIENCLOSED HARBORS,
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 2J.
W85-06929

POLLUTION CONTROL FACILITIES PROJECT SOUTHEASTERN OAKLAND COUNTY SEWAGE DISPOSAL SYSTEM, OAKLAND COUNTY, MICHIGAN: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 5G.
W85-06937

BIG CREEK FLOOD-CONTROL PROJECT CLEVELAND, OHIO: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
G. A. Pickering.
Technical Report HL-83-7, April 1983. Final Report. 51 p, 10 Fig, 10 Photos, 18 Plates.

Descriptors: *Hydraulic structures, *Flood control, *Floodways, *Model studies, Hydraulic models, Channels, Big Creek, Ohio, Hydraulic jump, Gabions, Flow control, Riprap.

Tests were conducted on a 1:40-scale model of Big Creek to investigate the hydraulic performance of a proposed floodway channel and a section of modified channel. The model reproduced the entire proposed floodway channel, a portion of the existing Big Creek main channel, and a section of modified channel downstream from the existing channel. Distribution of flow between the existing channel and the floodway channel was slightly different than anticipated, but this had no significant effect on flow conditions in either channel. Flow conditions were satisfactory in the concrete chute of the upstream end of the proposed floodway channel. A hydraulic jump formed at the lower end of the chute structure, resulting in satisfactory flow conditions at the entrance to the natural channel. The original design gabion drop structures used in the floodway to reduce the grade along the channel caused flow to concentrate near the middle of the channel, resulting in high velocities. Depths of flow in several reaches of the channel were less than anticipated. Revisions to these drop structures resulted in good flow conditions throughout the floodway channel. A concrete transition between the downstream end of a three-barrel conduit and the modified channel caused flow to concentrate in the channel which resulted in movement of the riprap immediately downstream from the transition and along the left bank. The concrete transition was removed and the area was shaped with riprap. This resulted in satisfactorily flow conditions in the modified channel. (Author)
W85-06994

EFFECTS OF VISCOSITY AND SURFACE TENSION ON SLOT WEIRS FLOW,
Naples Univ. (Italy). Dept. of Hydraulic Construction.
G. de Martino, and A. Ragone.
Journal of Hydraulic Research, Vol. 22, No. 5, p 327-341, 1984. 11 Fig, 21 Ref.

Descriptors: *Flow, *Slot weirs, *Surface tension, *Viscosity, Hydraulics, Construction, Weirs, Velocity, Head, Contraction.

An experimental investigation of the flow over vertical weirs, refered to as slot weirs on account of their markedly elongated rectangular shape, was carried out. Experiments on weirs 3 to 20 mm broad showed that, for heads greater than 6-7 cm and for each weir the coefficient of discharge remains practically constant as the head increases, the constant value being greater the narrower the weir. An increase in the influence of viscosity implies increments in the coefficient of contraction always prevailing over the decrements in that of velocity as arise from the loss of head due to viscous drag. An increase in the influence of surface tension will engender an increment in the coefficient of contraction exceeding the decrement in that of velocity, but only for values of W above a certain threshold, which is apparently a function of both the slot breadth and the head. Below such a limit, the decrements in the coefficient of velocity exceed the increments of the coefficient of contraction due to viscosity and to surface tension itself. Surface tension has, at low heads, the predominant influence on the process of motion and hence, in determining the particular behavior of the coefficient of discharge, which tends to decrease as the head is reduced. These exists, at least in the head range investigated, no threshold value of Reynolds' number, below which the influence of viscosity produces a reversal of its effects on the coefficients. The hypothesis appears justified that the singular point of contact between outflowing nappe and slot edge determines a modification of the kinematic process contraction (owing to a sudden change in direction), the contraction coefficient increments being comparatively higher the narrower the slot. (Baker-IVI)
W85-07029

TRAJECTORY OF A TURBULENT CROSS JET,
Indian Inst. of Tech., Kanpur.
K. Subramanya, and P. D. Porey.
Journal of Hydraulic Research, Vol. 22, No. 5, p 343-354, 1984. 7 Fig, 1 Tab, 18 Ref.

Descriptors: *Jets, *Turbulent flow, *Trajectories, Flow, Dispersion, Nozzles, Hydraulics, Fluid dynamics, Uniform flow.

Considerable effort has been directed in recent years towards understanding the behavior of turbulent jets discharging into streams. The trajectory of a round turbulent cross jet discharging at right angles into a uniform flow was studied. Using the experimental observations on the jet width and by momentum considerations the complete jet trajectory is shown to be given by a unique functional relationship. Using the experimental data of the present study plus other available data, the validity of the functional relationship is established. A semi-analytic approach has been used based on a properly defined drag coefficient. (Baker-IVI)
W85-07030

RIPRAP STABILITY UNDER WAVE ACTION,
Delaware Univ., Newark. Dept. of Civil Engineering.
N. Kobayashi, and B. K. Jacobs.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 111, No. 3, p 552-566, May, 1985. 7 Fig, 23 Ref.

Descriptors: *Riprap, *Wave action, *Mathematical models, Stability analysis, Mathematical studies, Coastal engineering.

A mathematical model was developed to predict the flow characteristics in the downrush of regular

waves and the critical condition for initiation of movement of armor units on the slope of a coastal structure. The analysis of water motion on the slope is based on the standing-wave solution of the finite-amplitude shallow-water equations with an implicit account of the effects of wave breaking. This simple model neglects the effects of permeability, bottom friction and water depth. In addition, use is made of an empirical runup relationship. A stability analysis of armor units is performed including the drag, lift and inertia forces acting on an armor unit which vary along the slope with time over the period of wave downrush. Comparison was made with the large-scale test data on riprap stability from an earlier study. The predicted critical stability number follows the same trend as the observed zero-damage stability number, although the agreement is qualitative. (Author's abstract)
W85-07079

STOKES AND RAYLEIGH LAYERS IN PRESENCE OF NATURALLY PERMEABLE BOUNDARIES,
Monash Univ., Clayton (Australia). Dept. of Mathematics.
For primary bibliographic entry see Field 2E.
W85-07099

CHARACTERISTICS AND MODELING OF INTAKE VORTICES,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
C. Farell, and A. R. Cuomo.
Journal of Engineering Mechanics, Vol. 110, No. 5, p 723-742, May, 1984. 7 Fig, 46 Ref, 1 Append.

Descriptors: *Vortices, *Intakes, *Model studies, Mathematical models, Free surfaces, Entrainment, Reynolds number, Froude number.

The effects of free-surface or boundary-attached vortices on the operation and performance of hydraulic structures and machinery are well recognized and of considerable concern to designers. A review and analysis of forces, equations and data for free-surface intake vortices is presented. In models which exhibit at most weak vortices entraining little air, preservation of the ratio of inertia and gravitational forces in model and prototype should assure the correct reproduction of intake circulation patterns. For large enough radial Reynolds numbers, while the vortex core flows are viscosity dependent and thus exhibit scale effects in Froude models, the effects on the gross features of the flow may be negligible. For vortices forming off a wall, the ratio of model-to-prototype core-pressure has been tentatively estimated assuming a solid fluid core. For air core vortices, small-scale Froude models may exhibit nonnegligible scale effects in the vortex cores, in particular in regard to air entrainment. (Moore-IVI)
W85-07100

CONVERGENT FLOW PATTERN AT AN ABRUPT CONTRACTION,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
For primary bibliographic entry see Field 2E.
W85-07101

HYDRODYNAMIC PRESSURE ON SHORT-LENGTH GRAVITY DAMS,
Johns Hopkins Univ., Baltimore, MD.
For primary bibliographic entry see Field 8A.
W85-07102

8C. Hydraulic Machinery

HYDRAULIC FORCES ON RAILS FOR VERTICAL LIFT, HIGH HEAD GATES,
D. G. Wardle, and D. A. Crow.
Proceedings of the Institution of Civil Engineers, Vol. 79, Part 2, p 73-85, March, 1985. 8 Fig, 8 Ref.

Descriptors: *Gates, *Rails, *Hydraulics, *Design criteria, Construction, Vertical lift gates, Head, Design criteria, Velocity, Pressure.

Where vertical lift gates are used under substantial differential water heads, it is usually necessary to minimize frictional resistances by providing the gates with wheels. A typical design procedure is to calculate the hydraulic loads transferred from the gate to the wheels, and thence to the rail, and, ultimately, to the concrete structure in which the gate is installed. Under some high velocity flow situations cases of failure of the concrete surfaces are known to have occurred as a result of the reconversion of velocity head into pressure head in joints and cracks. A similar mechanism may apply to gate rails, so consideration should be given to the hydraulic forces on the rails when the gate is partially or completely open. Tests were devised to demonstrated that a complex three-dimensional flow exists in the gate slots when vertical lift gates are in the open or partially open positions. High stagnation pressures, even approaching the full hydrostatic head, can develop in the vicinity of the downstream edge of the slot where the gate rail is fastened. The small gap behind the rail is likely to be large enough to allow the high stagnation pressures to occur behind the rail. Simultaneously, low pressures, even down to cavitating conditions, can exist on the open face of the rail next to the circulation eddy. There are likely to be significant resultant hydraulic forces on the rail tending to lift it from its mounting, and consideration must be given to the hydraulic forces when designing the fixings for such gate rails. The pressure difference across the rail should be equal to the velocity head of the flow through the gate opening. (Baker-IVI)
W85-06579

EXPERIENCE IN VIBRATION TESTS AND BALANCING ROTORS OF LARGE TURBINE-GENERATOR UNITS,
I. R. Solov'ev.
Hydrotechnical Construction, Vol. 18, No. 9, p 401-404, September, 1984. 4 Fig, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, September, 1984.

Descriptors: *Turbines, *Hydraulic equipment, *Vibrations, Rotors, Generators, Tests.

Vibration and mechanical tests of large turbine-generator units of hydroelectric stations revealed an unsatisfactory vibration state in some of them. Mechanical unbalance of rotors is one of the substantial and frequent operating defects of hydrostation units. The cause of occurrence of unbalance of the rotor is, as a rule, low-quality assembly, as a result of which distortion of the rotor shape occurs sooner or later, in the case of nonuniform wedging of the rim and also weakening of the wedging. As experience shows, mechanical unbalance of the generator rotor is not always the only cause of increased vibration of the unit. It usually occurs in combination with other defects of the unit; moveover, any change or correction of one of the defects affects the overall vibration state and wobble of the shaft of the unit. When balancing the generator rotor it is necessary to take into account all characteristics of the state of the given unit. For this a careful vibration check of the support assemblies and wobble of the shaft of the unit at various points over the length of the shafting is necessary. (Baker-IVI)
W85-06706

EXPERIENCE IN RECONSTRUCTING THE RADIAL GATE OF THE SPILLWAY AT THE VILYUI HYDROELECTRIC STATION,
A. I. Sitnyanskii.
Hydrotechnical Construction, Vol. 18, No. 9, p 414-418, September, 1984. 2 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 26-29, September, 1984.

Descriptors: *Radial gates, *Hydroelectric plants, *Vilyui Hydroelectric Station, Reservoirs, Spillways, Gates, Reconstruction, Ice.

The Vilyui hydroelectric station, having a carry-over reservoir, works for an isolated power system. A proposal to increase the normal pool level (NPL) of the hydrostation has been studied. The following problems were examined and solved during the studies: the possibility of passage of the spring and summer-fall floods at an increased NPL, reconstruction of the radial gate of the spillway, and check of the retaining structures during operation at an increased NPL. Reconstruction of the radial gate of the spillway by installing an additional gate on the sill under the existing gate proved to be an effective method of increasing the height of the gate, especially when the gate height is increased by 1.5 to 2 m and more. The capacity of the gate hoisting gear can be increased by increasing the mechanical advantage of the block and tackle with the installation of additional blocks and by increasing the capacity of the cable drum; such reconstruction increases the lifting capacity by 15-20%. A sectional strut-braced flashboard permits even under winter conditions draining the spillway sill and reliably protecting the zone of works on the sill. The use of hot water with a temperature of 50-60 degrees is an effective method of removing surface icing and fast ice on the perimeter of the gate if it is necessary to lift it in the winter, especially under conditions of the Far North. When installing a sectional strut-braced flashboard in front of a radial gate at temperatures of minus 40-50 degrees it is necessary to heat the water in the intergate space to preclude the formation of a thick ice cover and ice attached to the gate. (Baker-IVI)
W85-06708

SYNOPSIS OF INSULATION PROBLEMS AT YELLOWTAIL POWERPLANT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. C. Arbour.
REC-ERC-84-4, October 1983. 13 p, 12 Fig, 4 Tab, 1 Ref.

Descriptors: *Hydraulic machinery, *Powerplants, *Electrical equipment, *Hydroelectric powerplants, Electric powerplants, Yellowtail Powerplant, Insulation, Generators.

Unit 3 at Yellowtail Powerplant shut down on November 19, 1980, with a line-to-ground fault on phase A. Subsequent testing showed that the fault was located on the line end coil of one of the parallel groups. Examination of the faulty portion of the coil revealed that most of the strand binder material had decomposed into dust; some had disappeared entirely. The failure mode was primarily mechanical, caused by abrasion induced by electrical vibration. Corona testing on coils in other parts of the powerplant showed a number of high readings in three of the four units in the plant. As a result of the testing, plans were made to rewind the generators, starting with the most badly deteriorated units.
W85-06893

FILLING AND EMPTYING SYSTEM, WALTER BOULDIN LOCK, AND LOCK CULVERT VALVE FOR COOSA RIVER WATERWAY, ALABAMA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W85-06896

PERFORMANCE OF PLASTIC CANAL LININGS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
W. R. Morrison, and J. G. Starbuck.
REC-ERC-84-1, January 1984. 114 p, 83 Fig, 32 Tab, 39 Ref, 2 Append.

Descriptors: *Materials testing, *Seepage control, *Plastics, *Linings, *Canal linings, Irrigation canals, Polyvinyl chloride, Plasticizers, Canal seepage, Canal construction, Construction, Water loss, Leakage.

The performance of buried plastic membrane linings, primarily 10-mil PVC, was evaluated. Ten samples of linings, used for seepage control in irrigation canals, ranged in service life from 1 to 19 years. The buried plastic membrane linings evaluated in this study are providing satisfactory service for seepage control. A 20-mil membrane would

increase service life and reduce installation problems for a cost increase of only 15%. Laboratory studies and field observations indicated that some stiffening of the PVC lining has occurred with time. This stiffening or aging was caused by the loss of plasticizer. With aging, there was generally a reduction in elongation, an increase in modulus at 100% elongation, and a decrease in resistance to impact damage at low temperatures. The rate of this aging depended on three factors: (1) the linings with a high plasticizer content aged less, (2) samples obtained from within the water prism aged less than those obtained outside the prism, and (3) samples obtained from areas where the lining had been placed over a fairly smooth subgrade aged less than those installed over a coarser base. This report also presents design criteria, construction procedures, and updated construction and material specifications for PVC linings.
W85-06910

EVALUATION OF PUMPS AND MOTORS FOR PHOTOVOLTAIC WATER PUMPING SYSTEMS,
Solar Energy Research Inst., Golden, CO.
D. Waddington, and A. Herlevich.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-019163. SERI/TR-214-1423. June 1982. 53 p. 32 Fig, 5 Tab, 8 Append. Contract/Grant No. EG-77-C-01-4042.

Descriptors: *Pumps, *Solar energy, Pumping heads, Pumping tests, Wells, Test facilities, Flow rates, Costs, Cost analysis.

Two electric, motor-driven water pumps were tested in conjunction with a photovoltaic (PV) array that provided the electrical energy to run the pumps. The purpose of the tests was to evaluate the performance of currently available, low-cost pumping systems powered by PV arrays. The performance and cost of these systems were compared with analogous data from similar, higher priced pumps and motors currently used with many PV water pumping systems. The two pump systems considered represent production equipment available from U.S. industry and cost less than 50% of equivalent pumps installed with PV pumping systems in the U.S. and in developing countries. Flow rates, pumping heads, and efficiency were comparable in both test pumps and equivalent pumps. Motor performance, when the motor was directly connected to the PV array and loaded with the pump, was examined. It is concluded that commercially available, low-cost water pump systems will perform satisfactorily when powered by PV arrays.
W85-06988

8D. Soil Mechanics

EMPINGHAM DAM - DESIGN, CONSTRUCTION AND PERFORMANCE,
R. C. Bridle, P. R. Vaughan, and H. N. Jones.
Proceedings of the Institution of Civil Engineers, Vol. 78, p 247-289, April, 1985. 27 Fig, 2 Tab, 30 Ref, 2 Append.

Descriptors: *Empingham dam, *England, *Dam design, *Dam construction, Earthfill dams, Dam foundations, Drainage, Monitoring.

Empingham Dam (England) is the earthfill embankment 37 m high, 1200 m long. The dam foundation is Upper Lias clay extensively sheared and brecciated by valley bulging and periglacial disturbance. The weak foundation was the controlling factor in design and made a wide cross-section with extensive berms necessary. Determination of the reliable strength of the foundation was difficult and was to be confirmed at full scale by a trial bank placed early in construction and incorporated within the dam. The tender design allowed for the uncertain strength by indicating a range of dam volumes corresponding to the likely range of foundation strength values. Various measures, including 10,800 vertical sand drains and zoning of fills incorporating an inclined core, were utilized to minimize the volume of earthfill required. The bulk of the 5 M cu m of fill was Upper Lias clay excavated from borrow pits upstream of the dam, and was placed over three summer seasons. The performance of the dam is monitored by a comprehensive range of instruments, including a movement monitoring system. Finite-element methods were used to predict early movements. The instrumentation records show the behavior of the dam to be satisfactory. (Author's abstract)
W85-06174

ENGINEERING-GEOLOGIC SURVEYS AND FORECASTS FOR HYDROTECHNICAL CONSTRUCTION ON SLUMP-PRONE LOESS SOILS,
S. L. Skiba, I. F. Karyakin, and Z. M. Murtizaeva.
Hydrotechnical Construction, Vol. 18, No. 2, p 63-69, August, 1984. 3 Fig, 8 Ref. Translated from Gidrotekhicheskoe Stroiltel'stvo, No. 2, p 20-25, February, 1984.

Descriptors: *Loess, *Slump deformation, *Seepage, *Construction, Soil properties, Hydraulic structures, Soil mechanics, Deformation, Reservoirs, Reservoir management.

Unfavorable processes often develop during construction and operation of hydraulic structures constructed on slump-prone loess soils. Most of the problems are related to nonuniform slump deformations of primarily a vertical character occurring as a result of a change in the physical and mechanical properties of the soils under the prolonged action of water and the weight of the rocks and structures being constructed. As a result of the planning and surveying work done to determine the engineering and economic feasibility of a reservoir in an area with loess soils, a number of guidelines for construction in slump prone loess soils were developed. The types of problems addressed include the nature and character of slump deformations of loess soils; seepage properties and possibility and character of seepage deformations of loess soils; development of unfavorable engineering - geologic processes and phenomena as a result of the interaction of the hydraulic structures with slump-prone soils; methods of reducing or completely eliminating the slumping of soils; and design, construction, and operation of hydraulic structures on slump-prone soils, especially in seismically active regions. (Keenan-IVI)
W85-06591

EVALUATION OF THE ENGINEERING-GEOLOGICAL PROPERTIES OF CLAY FOUNDATIONS OF EARTH DAMS,
N. F. Aripov, S. V. Bortkevich, V. I. Vutsel', N. A. Krasil'nikov, and V. M. Ivannikov.
Hydrotechnical Construction, Vol. 18, No. 2, p 80-85, August, 1984. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Dam foundations, *Clay, *Earth dams, Monitoring, Measuring instruments, Embankments, Soil physical properties, Dam construction.

Engineering-geological investigations of earth dams having a weak clay foundation are insufficient to obtain complete and objective data on the geological and soil characteristics, because of the disturbance of the natural clay structure during the investigations as well as the insufficient consideration of specific characteristics of individual foundations. To overcome these shortcomings, the investigation of test embankments equipped with monitoring and measuring apparatus is recommended. This alternative approach allows the determination of the properties of weak clay soil in a natural and undisturbed manner. Field data obtained from two test embankments constructed in Mexico and France have demonstrated that this approach is feasible for investigation of weak clay foundation of earth dams. In order to promote an increase in reliability and economy of earth dams, refinements of the engineering-geological conditions of the foundation and properties of clay soil of earth dams being constructed should be carried out at the design stage to test embankments as well as in the initial period of construction of the real structure. (Shieh-IVI)
W85-06594

INFLUENCE OF GRAIN SIZE DISTRIBUTION ON THE UNDRAINED DYNAMIC PROPERTIES OF SATURATED SAND,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. L. McNearny.
July 1984. Thesis Submitted as Requirement for Degree of Master of Science, University of Colorado, Department of Civil and Urban Engineering, 1982. 163 p, 29 Fig, 13 Tab, 42 Ref, 5 Append.

Descriptors: *Soil mechanics, *Soil dynamics, *Sand, *Particle size, *Shear stress, *Soil water, *Saturated soils, Computer models, Model studies, Statistical analysis, Seismic properties, Hysteresis, Cyclic loads, Triaxial tests.

The gradation characteristics of a clean sand, as defined by the coefficient of uniformity and the mean grain size, did not influence the dynamic properties (dynamic shear modulus and damping ratio) when subjected to undrained cyclic loading. A functional relationship was seen between four of the five shear moduli and the level of shear strain. The damping ratios decreased with increasing shear strain over the strain range of 0.001 to 0.2 inch/inch. This conclusion was opposite to results of past research into the damping ratios of dry sand.
W85-06905

ANALYSIS OF FIELD COMPACTION DATA, DEGRAY DAM, CADDO RIVER, ARKANSAS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
W. E. Strohm, and V. H. Torrey.
Miscellaneous Paper GL-82-4, March 1982. Final Report. 102 p, 32 Fig, 6 Tab, 24 Plates, 5 Ref.

Descriptors: *Soil mechanics, *Hydraulic structures, *Dams, *Compaction, DeGray Dam, Caddo River, Arkansas, Earth dams, Earthworks, Embankments, Soil stabilization, Fill, Borrow pits, Construction, Density.

This report presents a review of the materials, specifications, procedures, equipment, and testing pertinent to construction and compaction control of the earth-fill embankment of DeGray Dam, Caddo River, Arkansas. The variation of fill water content from laboratory optimum water content and the variation of fill dry density from laboratory maximum dry density were statistically analyzed. The overall compaction control obtained for each major embankment zone is indicated by frequency histograms, cumulative frequency distributions, and various statistical parameters for variation of both water content and density. Fills in the core and shell zones were generally placed at average water contents slightly dry of optimum. The average value of fill percent compaction for the dam generally exceeded the desired value (100%) by 3 percentage points; for the dike (desired value, 98%), by 6 percentage points. Control of fill water content was better in the dam core than in the other sections of the dam. In the dike, better control was attained in the core and landside shell than in the remainder. The fill dry density for the dam and dike approached a normal frequency distribution. Better control of fill dry density variation was achieved in the dam's downstream shell and in the dike's core.
W85-06913

NONLINEAR RESPONSE OF COUPLED FLOW-STRESS PROBLEMS,
San Diego State Univ., CA.
M. N. Sharabi.
Journal of Engineering Mechanics, Vol. 110, No. 9, p 1303-1319, September, 1984. 5 Fig, 15 Ref, 1 Append. NSF Grant GK-35467.

Descriptors: *Flow, *Stress, *Mathematical models, Porous media, Deformation, Mathematical equations, Soil mechanics, Strain.

The main equations governing flow of fluid through deformable porous media are presented in a general form that considers finite deformations and nonlinear solid phase behavior. The mixture is assumed to be fully saturated, the fluid incompress-

ible and the solid nonlinear elastic. The balance of linear momentum and the continuity equations are given in Lagrangian form and a finite element procedure is presented for the incremental form of the equations of motion. The numerical model uses a modified bilinear interpolation for the displacement field and a bilinear interpolation for the pore pressure. For the temporal discretization, a finite difference technique with logarithmic interpolation. Numerical results are presented for several problems assuming infinitesimal strains. The mixture theory provides a consistent theoretical basis to describe the behavior of water transport in porous media. The computational study of the derived equations shows close agreement with the existing closed form solutions for the linear analysis. The influence of nonlinear soil skeleton properties shows a considerable deviation from the linear analysis. (Moore-IVI)
W85-07103

NONLINEAR HYSTERETIC DYNAMIC RESPONSE OF SOIL SYSTEMS,
Princeton Univ., NJ. Dept. of Civil Engineering.
J.-H. Prevost, A. M. Abdel-Ghaffar, and A.-W. M. Elgamal.
Journal of Engineering Mechanics, Vol. 110, No. 5, p 696-713, May, 1985. 13 Fig, 28 Ref. NSF grant CEE81-20757.

Descriptors: *Dynamic response, *Hysteresis, *Soil mechanics, Earth dams, Stress, Strain, Mathematical models, Earthworks, Kinematic plasticity theory.

A simplified analysis procedure for the nonlinear hysteretic dynamic response of soil or structural systems, or both, is presented. The method is based on a Galerkin formulation of the equations of motion in which the solution is expanded using basis functions defined over the spatial domain occupied by the soil system. The basis functions are selected as the normal eigenmodes of the linearized problem. The hysteretic stress-strain behavior is modeled by using elastoplastic constitutive equations based on multisurface kinematic plasticity theory. Accuracy and versatility of the technique are demonstrated by applying it to analyze the nonlinear dynamic response of an earth dam. The dam is modeled as a one-dimensional hysteretic shear wedge. Parametric studies assessing the influence of the nonlinearities on the response are presented. Finally, comparisons are made with results obtained through a more elaborate finite element representation of the dam. (Author's abstract)
W85-07104

8E. Rock Mechanics and Geology

EMPINGHAM RESERVOIR - SEEPAGE CONTROL MEASURES,
J. M. McKenna, P. Horswill, and E. J. Smith.
Proceedings of the Institution of Civil Engineers, Vol. 78, p 291-326, April, 1985. 20 Fig, 6 Tab, 25 Ref.

Descriptors: *Empingham Reservoir, *England, *Seepage control, Aquifers, Groundwater level, Hydrogeology, Geology, Relief wells, Reservoir construction, Postimpoundment.

The Marlstone Rock Bed provides a potential seepage path for water from Empingham Reservoir. The Marlstone is an aquifer up to 2.5 m thick underlying the Upper Lias clay forming the bed of the reservoir. It has been affected by valley bulging, resulting in suballuvial outcropping along the valley floor. Local and regional investigations were carried out including cataloguing of old well records, sinking boreholes, analyzing river-water chemistry and carrying out field seepage trials. Much additional hydrogeological data was obtained after dewatering of the aquifer after the rupture, early in the construction period, of the base of a tunnel shaft caused by uplift from the water pressure in the Marlstone. The investigations revealed that the pre-reservoir behavior of the aquifer was controlled largely by an outlet into an adjoining valley, and that changes in groundwater levels there might result in landslipping so it was concluded that post-impounding levels near the outlet must not be allowed to exceed pre-reservoir levels. Various means of preventing seepage were considered but the most appropriate solution was to install relief wells downstream of the dam to release the additional water. Soon after first filling of the reservoir a sudden rise in levels and discharges occurred. Extra relief wells were installed while unsuccessful searches were made for connections through the reservoir floor into the Marlstone. Various other causes were considered but the mechanism is not fully understood. However, the discharges soon stabilized to acceptable values and the behavior of the aquifer continues to be satisfactory, with a steady discharge from the relief wells about 185 l/s. (Author's abstract)
W85-06175

EXPERIENCE IN THE USE OF SATELLITE PHOTOGRAPHS FOR ENGINEERING-GEOLOGICAL CHARACTERIZATION OF CONSTRUCTION SITES OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 7B.
W85-06589

METHODS OF DETERMINING THE STRESS STATE OF ROCK MASSES AT CONSTRUCTION SITES OF HYDRAULIC STRUCTURES,
V. D. Parfenov, A. I. Savich, and Y. A. Fishman.
Hydrotechnical Construction, Vol. 18, No. 2, p 15-19, February, 1984. 1 Fig, 1 Tab, 15 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 15-19, February, 1984.

Descriptors: *Stress, *Rock mechanics, *Geology, Deformation, Geophysics, Strain gages, Boreholes, Geologic fractures, Semiacoustic method, Foundation rocks, rock testing.

For understanding the natural stress state of rock masses, three groups of methods are used: deformational, geophysical and geological. Deformational methods measure deformation upon removal of rock material (strain relief) or measure the strain needed to restore a deformed void to its original position (compensation). The borehole relieving method uses strain gauges (10-15 mm) which may only measure stresses pertaining to elementary rock units and not to the entire rock mass. Larger cavities would provide large measurement bases, substantially exceeding the dimensions of elementary rock blocks. To gauge how stress changes with time, photoelastic methods or alternatively a slot method can be used. The slot method allows one to determine average stresses in the plane of the excavated slot and is accomplished by placing a flat hydraulic jack or 'cushion' which acts as a deformometer into a test slot freshly cut from the surrounding rock. Stress dependence of seismic velocities in geologic media is governed not only by their elastic properties but also by jointing, anisotropy, and lithologic and structural inhomogeneities. Two geophysical methods for evaluating stress have been developed, the correlation method and the seismoacoustic method. Data obtained using the correlation method indicate complex states of stress for near surface rocks and that horizontal stress components considerably exceed the value of the vertical components. Geologic stress measurement methods are generally aimed at reconstructing the paleostress state of rocks using permanent strain elements and fractures. These methods are based on kinematic analysis of the spatial distribution of displacement vectors, slip, fracture distribution and crystal element orientation. The analysis can be done statistically, or geometrically using a Wulff stereographic net. (Giegangack-IVI)
W85-06590

EXPERIENCE IN STUDYING TECHNOGENIC UNLOADING IN CONSTRUCTION PITS,
V. N. Andreev, and L. D. Lavrova.
Hydrotechnical Construction, Vol. 18, No. 2, p 70-74, February, 1984. 2 Fig, 1 Tab, 3 Ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 2, p 25-28, February, 1984.

Descriptors: *Geology, *Stability, *Construction, *Foundations, Hydroelectric plants, Rocks, Dam foundations, Geologic fractures, Locks, Rock slopes.

At the site of the Dnepr-II hydrostation, unloading was studied in the sides of the pit of the second lock, 40 m deep. The lock is located in grey, highly metamorphosed Archean plagioclase granites of the Zaporozhe massif. The rock mass is severely broken by tectonic joints and in the near-surface part by short, sinuous release joints. The thickness and character of the technogenic unloading zone depend on the degree of jointing and crushing of the mass, its weathering, depth of excavating the pit, and blasting method. The results of studying technogenic unloading made it possible to regionalize the foundation according to the degree of unloading and jointing of the rocks; to construct a model of jointing with unloading zones characterizing various parts of the mass and serving as the basis for calculating the stability of rock slopes and foundation of concrete structures; or to refine the contours of the cut for concrete structures at the site of the Krapivinskii hydropower project; to develop stabilization measures (anchoring of the pit sides), which saved 400,000 rubles (Dnepr-II). The results of this study are being used for refining the parameters of contact grouting and the grout curtain, siting drainage structures, and installing monitoring equipment in the rock foundation of concrete structures. (Baker-IVI)
W85-06592

BASIC PRINCIPLES OF RECOMMENDATIONS ON ON-SITE OBSERVATIONS OF DEFORMATIONS OF ROCK FOUNDATIONS OF HIGH CONCRETE DAMS,
G. K. Khakimova.
Hydrotechnical Construction, Vol. 18, No. 2, p 75-79, February, 1984. 1 Tab, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 28-31, February, 1984.

Descriptors: *Dam foundations, *Foundation rocks, *Deformation, Foundation failure, Monitoring, Measuring instruments, Displacement, Concrete dams, Dam construction.

Methods for determining and monitoring on-site horizontal and vertical displacement as a means to assess the deformation of the rock foundations of high concrete dams consist of several measurement techniques and comparison of data with mathematical models. The deformation of rock foundations can be observed using geodetic and specially embedded, monitoring equipment. Vertical displacements are determined using bench marks and direct leveling (accuracy 1-2 mm). Less accurate, trigonometric leveling applicable for inaccessable areas and hydrostatic leveling applicable only for closed spaces (accuracy 0.03-0.25 mm) can also be used. Horizontal displacements may be evaluated by triangulating, using plumb lines (accuracy no less than 0.1 mm), rock deformometers and gap meters (accuracy of approximately 5 mm) or deep bench marks (accuracy of the order of fractions of a millimeter). Reference points should be chosen so that they are outside the zone of influence of the structure under observation (1.5-5 km from the dam) and so they are underground but tie in to local vertical and horizontal control networks. Instruments which monitor effects of decompression resulting from excavation should be located at different depths in order to constrain the extent of maximum decompression. The same instruments and observation points should be used over time in order to ensure consistancy. Observations should begin before construction, carry on for at least five years until stabilization has occurred and then can be reduced but never phased out. When comparing actual results to a theoretical model a 20-30% difference in displacement values is considered acceptable. Post-construction detailed analysis may be required in order to evaluate unforseen complications or original model shortcomings. Neither direct comparison of actual and theoretical data nor statistical analyses provide insight into the physical causes of deformation, therefore it may be necessary to study these cases using direct examination or rather complex mathematical models. (Giegangack-IVI)

W85-06593

STRENGTH OF A JOINTED ROCK MASS,
A. B. Fadeev, and I. I. Protopopov.
Hydrotechnical Construction, Vol. 18, No. 2, p 91-95, February, 1984. 5 Fig, 1 Tab, 13 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 40-43, February, 1984.

Descriptors: *Rock mechanics, *Jointing, *Strength, Geological fractures, Mathematical equations, Deformation, Weathering, Blasting.

Rock masses are usually penetrated by joints grouped into several sets. The presence of jointing reduces the strength of the rock mass compared with the strength of a small sample, and a nonuniform distribution of joints in space imparts strength anisotropy to the mass. Joints, joint sets and their distribution relative to local compressive stress are examined in order to develop a working formula for determining the coefficient of structural weakness of rock or a rock mass. On-site stress tests can be conducted and measurements of stress can be made by observing the deformation of a test rock block. These so called strain relief methods offer varying degrees of accuracy. The most accurate method utilizes a test block cut on five sides. Other strain relief methods utilize blocks cut on four sides or slots cut out of the surrounding rock. Inverse calculations are used in order to estimate the strength properties of a particular rock mass. In the equation developed, the coefficient of structural weakness is a function of the rocks composition and strength and also the orientation and density of joints or joint sets relative to the direction of maximum compressive stress. Tables of coefficient values range from 0.03 to 0.06. The minimum value for the strength of the loaded portion of a mass relative to the distribution of the local structural elements should be used when estimating its stability. Exposure to natural weathering and blasting caused a marked decrease in the strength properties of a given rock mass. (Giegangack-IVI)
W85-06596

GEOLOGICAL AND SEISMOLOGICAL INVESTIGATIONS AT RIRIE DAM, IDAHO,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
D. M. Patrick, and C. B. Whitten.
Miscellaneous Paper GL-81-7, September 1981. Final Report. 139 p, 52 Fig, 3 Tab, 21 Ref, 2 Append.

Descriptors: *Geologic fractures, *Dam foundations, *Dam stability, *Damsites, *Seismology, *Seismic properties, *Core drilling, *Rockfill dams, Earth dams, Earthquakes, Aerial photography, Satellite technology, Seismic waves, Remote sensing.

Geological and seismological studies were conducted at Ririe Dam to identify and define potential seismic hazards at the site and beyond. The studies were supplemented by core drilling data, aerial photography, LANDSAT imagery, and aerial overflights. Regional fault studies indicated that active or capable faults were present in the Yellowstone National Park (YNP) area. High levels of seismicity were detected in the YNP area and along the Utah-Idaho border and intermediate levels occur in the Caribou Range south of the site and to the west of Palisades Reservoir. Seismic velocity levels at the dam site and the nearby Snake River Plain (SRP) were low. On the basis of seismicity and tectonics, three seismic zones - A, B, and C - were identified. Zone A was the YNP area about 105 km from the site. Zone B included the seismically active area along the Utah-Idaho border and within approximately 40 km south of the site. Zone C included the SRP, the site and areas between A and B. These studies resulted in the conclusion that two offsets in basalt flows in the embankment foundation were due, in one case, to a landslide and, in the other, to topography. The design basis earthquake ground motions are those from Zone B, and the operating basis earthquake ground motions are those from Zone C.
W85-06966

8F. Concrete

DURABILITY OF REINFORCED CONCRETE BEAMS EXPOSED TO MARINE ENVIRONMENT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
E. F. O'Neil.
Miscellaneous Paper SL-82-1, April 1982. Final Report. 18 p, 8 Fig, 2 Tab, 2 Ref.

Descriptors: *Concrete testing, *Weathering, Concrete technology, Reinforced concrete, Marine environment, Durability.

A study was begun in 1950 to determine the effects of severe natural weathering on stressed, reinforced concrete beams of various composition and degrees of stress. The beams were placed on the beach at the natural weathering exposure station on the south side of Treat Island, Cobscock Bay, Eastport, and Lubec. The beams were subjected to twice daily tidal cycles exposing them to wetting under considerable head and drying to surface dry conditions. During the winter months, the beams were also subjected to cycles of freezing and thawing. The beams were inspected annually and evaluated to determine the degree of deterioration. Maximum crack widths were also measured annually beginning in 1956 and continuing until 1975, when the exposure period was concluded after 25 yr. of weathering. At the end of the exposure period, 13 of the 82 beams still remained at the testing site. (By 1956, 60 of the beams, all fabricated from nonairentraining concrete, had been destroyed by freezing and thawing.) Of the 13 beams remaining in 1975, 11 were returned to the laboratory for testing. The results of the exposure study and the laboratory investigation indicated that stressing the steel to various levels over the exposure period did not adversely reduce the moment carrying capacity of the beams even though rusting and spalling had occurred; corrosion to the steel could not be found at any flexural crack < 0.40 mm; and sustained levels of stress to the reinforcing did not reduce the tensile properties of the steel to below acceptable standards.
W85-06986

8G. Materials

EVALUATION OF MEMBRANE-TYPE MATERIALS FOR STREAMBANK EROSION PROTECTION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
For primary bibliographic entry see Field 4D.
W85-06979

8I. Fisheries Engineering

EVALUATION OF TILAPIA SPP. IN LAKE MANZALAH AS POND FISHES, (PROCJENA TILAPIA SPP. U JEZERU MANZALAH KAO RIBNJACARSKIH VRSTA),
Institute of Oceanography and Fisheries, Alexandria (Egypt).
For primary bibliographic entry see Field 6G.
W85-06424

SEASONAL VARIATION OF DISSOLVED ORGANIC MATTER IN FUNKA BAY,
Hokkaido Univ., Sapporo (Japan). Research Inst. of North Pacific Fisheries.
For primary bibliographic entry see Field 2L.
W85-06441

FORMATION OF ICHTHYOFAUNA IN THE SASYK RESERVOIR UNDER CONDITIONS OF FRESHENING (FORMIROVANIE IKHTIOFAUNY SASYKSKOGO VODOKHRANILISHCHA V VSLOVIYAKH OPRESNENIYA),
For primary bibliographic entry see Field 6G.
W85-06468

STUDY OF A SHALLOW CARP (CYPRINUS CARPIO L.) POND AND ITS RELEVANCE TO INLAND FISH FARMING IN LIBYAN JAMAHIRIYA,
Garyounis Univ., Benghazi (Libya). Dept. of Zoology.
C. S. Wood, and S. A. Ghannudi.
Aquaculture, Vol. 44, No. 2, p 125-131, February, 1985. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Fish farming, *Aquaculture, *Carp, *Libya, Climates, Temperature effects, Salinity, Solar radiation, Reservoirs, Fish food.

The construction of rainwater storage reservoirs in the Libyan Jamahiriya for agricultural purposes may provide opportunities for culturing fish on a large scale. Environmental variations were studied in an artificial experimental pond in an effort to find out the suitability of Libyan conditions for fish farming. While the results obtained with the fish cannot be extrapolated to compare the yield in large field conditions, the performance of the fish under Libyan environmental conditions seems to be equal to normal standards. Water temperature data are also favorable for the growth of carp. Adult mirror carp consumed all mollusks and higher plants and were feeding on Cyanophyta prior to spawning in May 1978. The young grew to 136 mm fork length and yielded 2.2 kg in 14 months without food or fertilizers being added. They stayed under cover for five winter months and at this time growth was not affected much. Quantitative or semi-quantitative data are given for water depths, salinity balance, maximum and minimum water and other temperatures, solar radiation, and for biomass of producer and consumer species, together with observations on algal species, carp and goldfish. (Baker-IVI)
W85-06486

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 5, FISH STUDIES: PILOT REPORT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. H. Pennington, H. L. Schramm, M. E. Potter, and M. P. Farrell.
Miscellaneous Paper E-80-1, November 1980. Report 5 of a Series. 101 p, 6 Fig, 23 Tab, 1 Append.

Descriptors: *Aquatic habitats, *Fishing gear, *Fish populations, *Sampling, *Baseline studies, *Species composition, *Species diversity, *Lotic environment, Stream fisheries, Habitats, Fish, Biological samples, Rivers, Nets, Gill nets, Standing waters, Trawling, Banks, Dikes, Channels, Sandbars, Fisheries.

A pilot study was conducted on the Lower Mississippi River (mile 480 to 530) to familiarize field crews with habitats, test sampling gear and study procedures. The diversity of sampling gears used adequately represented the fish fauna of most habitats. Seines were valuable for estimating diversity and abundance in shoreline habitats, hoop nets and electroshocking were effective along natural and revetted banks, dike fields and other lotic habitats, and gill nets were useful in slack-water areas. Trawling was effective in dike fields and areas with unobstructed bottoms. Catch per unit effort (C/f) was used as an index of fish abundance. C/f varied over time, among habitats, sites within a habitat, and between samples within a habitat. The standing-water fish community was most abundant in abandoned channels and the oxbow lake. C/f in flowing water was highest in the chute joining Lake Lee with the river. The lotic fish community was collected in similar abundance from the natural bank, revetted bank, dike field, sandbar, and temporary secondary channel habitats, with the temporary secondary channel habitats showing the greatest abundance. Standing-water, flowing-water, and inshore fish communities are well represented in dike fields.
W85-06943

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE

480-530; REPORT 4: DIEL PERIODICITY OF BENTHIC MACROINVERTEBRATE DRIFT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2A.
W85-06995

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

DESIGN OF A WATER RESOURCES TRAINING PROGRAM FOR OPERATION, MAINTENANCE AND MANAGEMENT,
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt, T. J. Karikari, and A. Bunyan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157600/AS, Price codes: A10 in paper copy, A01 in microfiche. D.C. WRCC Report No. 56, October 1983. 207 p, 4 Fig, 13 Tab, 140 Ref, 10 Append.

Descriptors: *Training, *Water distribution, *Sewer services, *Job analysis, *Wastewater treatment, Plant operation, Maintenance, Management, Curriculum development, Need-to-know, Local organization, Washington (DC), On-the-job training, Apprenticeship, Certification.

A long-term training program was designed for operating personnel in three bureaus (Water Services, Sewer Services, and Wastewater Treatment) within the Water Resources Management Administration (WRMA), a division of the D.C. Department of Environmental Services (DES). The project consisted of: an analysis of the agency's structure; a survey of the employees background; a survey of job and task requirements; an assessment and documentation of training needs based on workers and supervisors views; analysis of job and performance functions; and the implementation of a pilot program aimed at providing information about the training level of workers, trainees and supervisors acceptance, selection of training methods, training facilities, and other factors relating to a long-term training program. Recommendations on a comprehensive long-term curriculum leading to certification are provided. The report also gives guidelines for apprenticeship, certification and a comprehensive list of courses related to the training of water resources operators and technicians.
W85-06308

INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT REPORT 1981 (ICLARM).
International Center for Living Aquatic Resources Management, Manila (Philippines).
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-114249. 1982. 112 p. Edited by Jay L. Maclean.

Descriptors: *Aquaculture, *Fisheries, *Resources development, Education, Resources management report, Resources allocation, Research.

This annual report of the ICLARM has sections on its research programs in aquaculture, traditional fisheries, resource development and management, and education and training; information service; advisory services; conferences, symposia, courses, and workshops; a list of papers presented at conferences and seminars; publications; linkages and agreements; and sources and application of funds.
W85-06977

9D. Grants, Contracts, and Research Act Allotments

ANNUAL REPORT OF GEORGIA WATER RESOURCES RESEARCH INSTITUTE ACTIVITIES UNDER PUBLIC LAW 95-467 IN FISCAL YEAR 1983,
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
B. Kahn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157774/AS, Price Codes: A04 in paper copy, A01 in microfiche. Report No. ERC 08-84, September 1984, 46 p, 5 Tab, Project No. USGS G-836(01).

Descriptors: *Water Resources Institute, Water resources research and training, *Georgia, Groundwater, Water use, Sedimentation, Acid rain.

The FY 1983 Program included the following seven projects: Municipal Use of Existing Wells for Supplemental Water Supply in the Piedmont and Blue Ridge Provinces of Georgia, by James E. Kundell and Robert C. Chambers, Parameter Identification in Layered Aquifer Systems, by M. M. Aral and M. Zakikhani, Long Term Sediment Deposition in the Riparian Zone of an Agricultural Watershed, by Richard Lowrance and James Cooley, Characterization of Acid Rain Phenomena, by Kevin C. Beck and Judith Demere, Geological Factors Influencing Well Productivity on the Georgia Piedmont, by George A. Brook, Chinhong Sun and Terrence S. Lloyd, Fracture Trace Analysis to Increase the Probability of Locating Ground-water in Murray County, Georgia, by R. E. Tschirhart, D. W. Kolberg, and N. L. Faust, Effective Use of Cooling Lakes and Cooling Towers in Hybrid Cooling Systems, by Terry W. Sturm. The research was supported by Federal (US Dept. of the Interior) and State funds and performed at the University of Georgia Institute of Technology during the period June 1983 - September 1984. Technical completion reports of all projects are available from the Environmental Resources Center publication series under the numbers 0184 to 0784. The Environmental Resources Center managed these and associated training and information transfer activities as the state water resources research institute. During this period, also, all ongoing research projects from earlier years were completed and published.
W85-06320

FY 83 PROGRAM SUMMARY REPORT OF UTAH CENTER FOR WATER RESOURCES RESEARCH,
Utah Water Research Lab., Logan.
L. D. James.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85 157790/AS, Price codes: A04 in paper copy, A01 in microfiche. General Series UWRL/G-84/01, Sept. 1984. 52 p, 2 Tab, 17 Fig, 50 Ref, Project No. USGS G872-01.

Descriptors: *Utah, *Water resources research, Groundwater pollution, Salinity, Irrigation, Aquifer characteristics, Soil chemistry, Saline soils, Alluvium, Subsoil, Model studies, River basin development, Management planning, Water allocation, Resources development, Drinking water, Water treatment, Filtration, Particulate matter, Turbidity.

The FY 1983 research program funded cooperatively by the U.S. Geological Survey and The Utah Center for Water Resources Research supported four projects. Studies were completed on 1) the effectiveness of direct filtration in drinking water treatment and 2) organizing a modeling capability for systematic application to water management issues in the Colorado River Basin. More stringent standards are causing many communities to treat to remove drinking water turbidity. Mixed media filters permit the direct filtration without passing the water through costly settling basins. The objective of this research was to compare the performances of direct filtration and conventional treatment plants. The data showed no significant difference and that direct filtration produced a water easily meeting the standard of 1 TU required by EPA. Studies will continue into FY 1984 on 1) instrumenting the buildup of groundwater salinity to collect data for use in geohydrologic and geochemical modeling to guide farm water management for soil salinity control and 2) measuring water salinity levels in observation wells between fields and drains to model the induced upward movement of salts from underlying saline formations to guide the design and operation of irrigation systems serving agricultural lands with this problem. These continuing studies continue a long series of Center projects on salinity control at the river basin level and fit within the framework formulated in the systematic assessment of modeling in the Colorado River Basin.
W85-06322

INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT REPORT 1981 (ICLARM).
International Center for Living Aquatic Resources Management, Manila (Philippines).
For primary bibliographic entry see Field 9A.
W85-06977

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

ANIMAL SUBSTRATE RELATIONSHIPS AND PRODUCTIVITY OF INVERTEBRATE MACROBENTHOS OF MISSISSIPPI SOUND AND ADJACENT COASTAL AREAS: A BIBLIOGRAPHY WITH ABSTRACTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2L.
W85-06911

10F. Preparation Of Reviews

JET ENTRAINMENT IN PUMPED-STORAGE RESERVOIRS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 8B.
W85-06921

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